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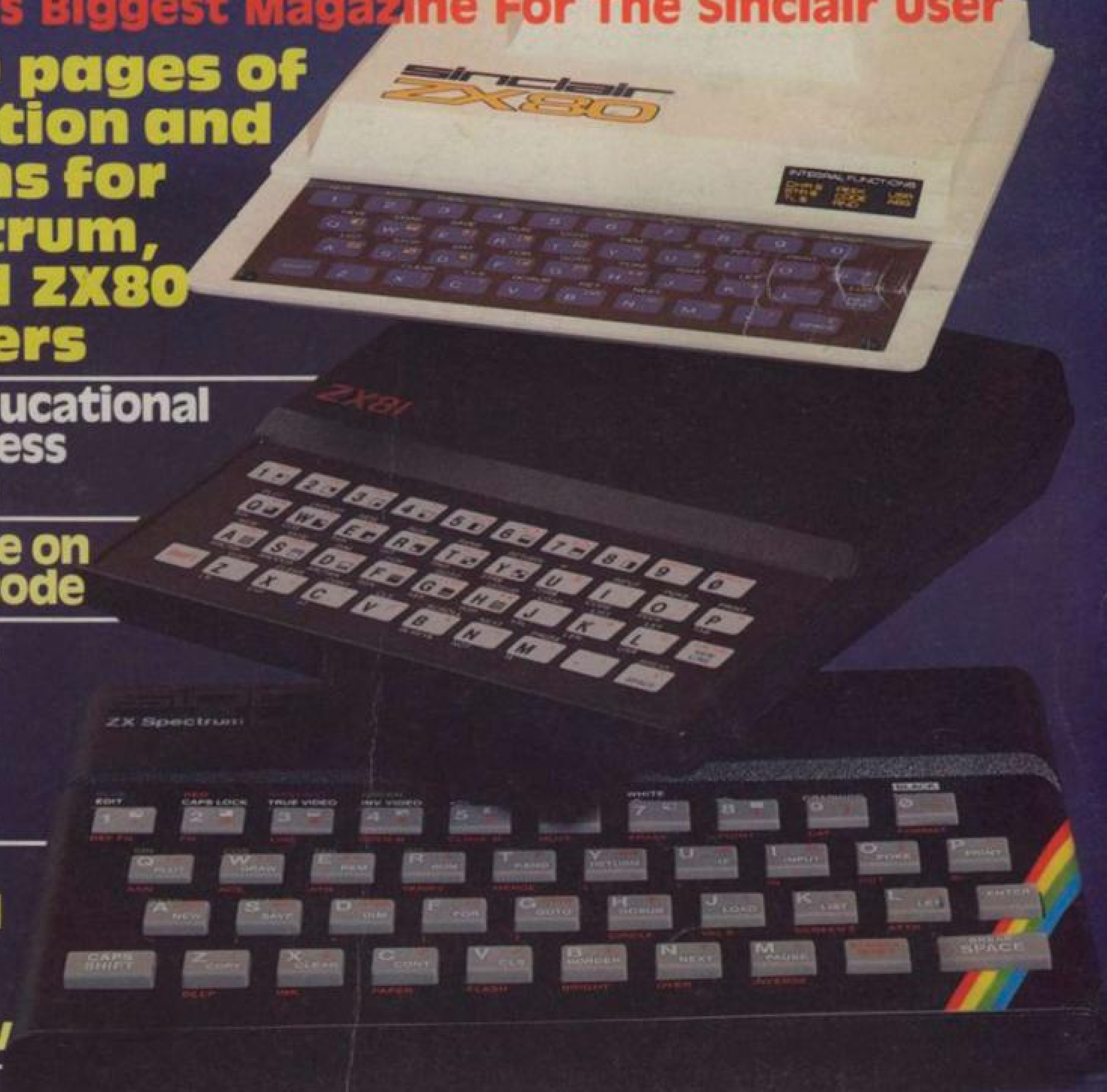
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ZX COM

ZX Computing
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April/May 1983

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CONTENTS

Letters 8

Is someone out there having the same problems as you? What does everyone think of the latest software on the market? Has anyone found anything about their machine that you haven't found on yours? This is the place to look...

Better Programming ... 13

Robert Speel has a new book out this month called 'Better Programming on your Spectrum and ZX81'. We present a sneak preview.

Air Raid 18

Have an explosive time on your ZX81 with this program written for us by Stephen Ormrod.

Sinclair Software For Your '81 24

Nick Pearce checks out the latest software titles from the Sinclair stable. Do they come up to scratch?



Adding On Your Spectrum 27

If you thought the ZX Spectrum was an 'all-singing, all-dancing' micro, just wait until you see it in action with some of the peripherals available. You'll almost believe a micro can fly.

Sheepdog Trial ... 36

Not so much of a trial, but Guy Morgan definitely assumed you'd enjoy a tactical game when he wrote this program on his ZX81.

Machine Code Tutor 40

Stand up all those who don't understand machine code. Well, don't just stand there — sit down and read this article!

F.A. Cup 44

It's on the road to Wembley with this fun listing from GL Maynard for you and your Spectrum.

The Learning Process 48

An educational package which comprises a book and a cassette as part of the learning process? James Walsh takes a look and reports back with his impressions.

Clocking On 51

Got the inclination? Then, just type this into your Spectrum and thanks to Ben Rimmer, you'll soon have the time.

News 53

All the news from Sinclair Research, the latest software and hardware announcements. Read it here first.

Club Corner 58

Another selection of user clubs dedicated to the Sinclair computers, eager for your attention and support.

Battleships 60

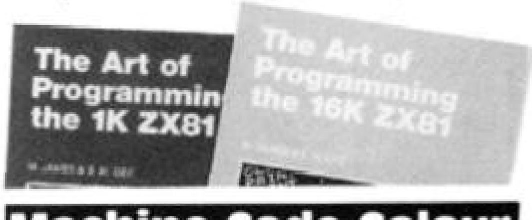
Anchors away, Spectrum at the ready and it's off to sea. A splendid adaptation of the classic old favourite, from Jeff Hamilton.

Stock Control 65

Keep your business stock in order with this fine program written by Neil Streeter. Although written for the ZX81, there are notes on conversion to the Spectrum.

Bookshelf 68

Patrick Cain dons his reading glasses and pores over another selection of computer books for your library.



Machine Code Colour Graphics 74

Robert Erskine takes on the challenging subject of creating colour graphics on his Spectrum using machine code — not for those of a nervous disposition!

MPUTING

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The Hobbit 76

You've read the book, and seen the film. . . now play the computer game on your ZX Spectrum. Phil Garrett takes us on a guided tour of Middle Earth.



Horsing About . . . 79

Andrew Haslem saddles up his ZX80 with this horse-race game.

Competition 81

Your chance to win a library of books for your Spectrum library. All you have to do is to tell us where the authors are. . .

Into The Fourth Dimension 83

If you thought that three dimensions were enough for a computer game, then join Phil Garratt as he delves into the fourth dimension.

Adding Interest To Your Programs — part one 84

Tim Hartnell, programming author extraordinaire, begins a two-part feature on how to make your programs that bit more interesting.

Spectramon — part one 88

The first part of a feature by Simon Goodwin in which he explains the workings of his incredible diassembler listing for the 48K Spectrum.

On Target 92

Timothy Panell presents a double bill of programs for your ZX81.

Asteroids Ahead . 94

Watch out for the asteroids as you steer your spaceship through deepest space. A program for your Spectrum by Clyde Bish.

User Character Set 98

Define a whole new set of characters on your ZX81, with a little bit of help from David Mold, of course.

ZX-CESIL 2 — part one 104

John Miller begins his adaptation of the educational computer language, CESIL 2.

Number Tumbler 108

Watch those numbers tumble in this game of chance from Mark Berke.

Circuit Sketch . . . 111

The perfect program for the electronic hobbyist. An electrifying listing for your Spectrum written by GL Maynard.

It's All A Game . . . 114

James Walsh compares a selection of the latest arcade-style software packages for the ZX Spectrum.

Mastering Machine Code On Your Spectrum 118

This issue, Toni shows you how to make music on your Spectrum using machine code.

Software Selection 122

A comprehensive guide to the software market for the ZX81 and Spectrum computers. Complete with details of price, etc, you'll also find a list of supplier's addresses.



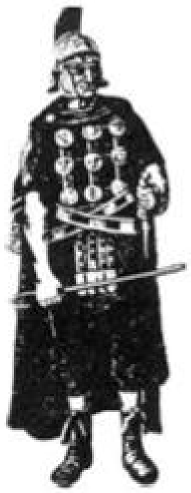
Machine Specifications . . 133

A reference guide to the Sinclair range of products. It's all here.

ZX Computing is constantly on the look-out for well-written articles and programs. If you think that your efforts meet our standards, please feel free to submit your work to us for consideration.

All submitted material should be typed if possible; handwritten work will be considered, but please use your neatest handwriting. Any programs submitted should be listed, a cassette of your program alone will not be considered. All programs must come complete with a full explanation of the operation and, where relevant, the structure; Spectrum programs should be accompanied with a cassette of the program (which will be returned) as well as the listing.

All submissions will be acknowledged and any published work will be paid for at competitive rates. All work for consideration should be sent to the Deputy Editor at our Charing Cross Road address.



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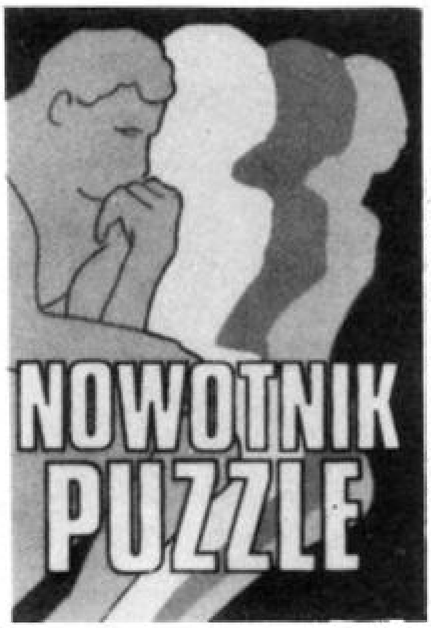
All games contain comprehensive playing instructions and they play differently at each level (where applicable) and on each occasion. All ZX 81 need 16K Ram. All Spectrum will run on 16 or 48K. PRICES: SPECTRUM **£5.50**: ZX 81 **£4.50**: (DRAGON **£6.95**)

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Somewhere amid this maze of burial chambers lurks an Evil Sorcerer whom you need to trap. Trouble is, he's protected by Trolls, Dwarves, Serpents and the occasional Dragon or two! Your magic staff will block the tunnel to prevent him escaping... unless, that is, he outwits you.

A real brain twister, White Barrows requires both brains and brawn from its players. It's no good just hacking your way through the Barrows and hoping to fall over the Sorcerer. Eventually you'll meet a Dragon — and they don't hack easily! You'll need all your cunning and strength to survive this one for long.

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CONQUERING EVEREST — Program approximately 11K

So, you think climbing mountains is all about scrambling over rocks? This superb piece of programming will soon change all that!

You are in charge of an expedition comprising 18 climbers, 34 Sherpas and 40 Porters. There is food, tents and equipment for all, including the oxygen you'll need as you near the summit. Trouble is, it all starts at the BOTTOM of the mountain and you have to get it all to the TOP! Each route upward must be forced and any camp you make must be properly supplied, otherwise the expedition members will retreat down the mountain.

The monsters in this game are avalanches, starvation, storms and worst of all, bad planning! A real thinking person's adventure, Everest will test your skill and forward planning to the limit.

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Welcome



Hello there, glad you could join me for another ZX Computing, as usual stacked with information for your Sinclair computer.

In this, our sixth issue, there is the usual mix of programs for your Spectrum, ZX81 and ZX80, covering a wide range of interests such as business, domestic, educational, games and utilities. There are also articles and programs specifically written to help the beginner master the art of programming, and others to further develop the skills of the experienced Sinclair user.

Inside information

Before you start flicking through the pages of this magazine to savour the contents, let me first whet your appetite.

As more of you are flexing your programming skills on your Spectrums, so more of you are sending in your programs for possible publication in ZX Computing. And I'm happy to say that the standard set so far has been very high. This is more than borne out by programs such as Circuit sketch by G L Maynard and Battleships by Jeff Hamilton.

I am also pleased to include the first part of a two part article called Spectramon. This article introduces you to Simon Goodwin's incredible disassembler program for the ZX Spectrum, the full listing of which will appear in the next issue.

Of course, that's not to say that the quality of ZX81 programs has in any way diminished. We are including some strong programs for this computer including Stock control, a fine business listing written by Neil Streeter, which could benefit any company; and Sheepdog trial by Guy Morgan and Air raid by Stephen Ormrod for a bit of fun.

And for all those would-be machine code masters, Toni Baker continues her excellent series on getting to grips with machine code on your Spectrum with some hints on making music. Also, Mark Wenham delves deep into the mysterious world of machine code to bring us an easier method of making sense of certain instructions.

As usual, our reviewers have been up to their necks in the latest software and publications for the ZX81 and ZX Spectrum, and their reports are included within these pages. Also, turn to the news pages for what's new in software, hardware and computer clubland.

Speciality of the house

This issue contains a couple of special features which I hope will prove useful in your assessment of the ZX market.

The first is a brief guide to hardware add-ons for the ZX Spectrum. In this feature, our review team takes a quick look at the various pieces of hardware, complete with details of operation and ease of installation. Although, it had been initially planned to include keyboards in this feature, there was so much hardware available that to do the keyboards justice, we will be looking at them in detail in a forthcoming issue.

Our other special feature this issue is the Software selection. In what must be one of the most comprehensive guides to ZX software, you will find the titles, names of the publishers, amount of memory required to run each program, and the price of the package. There is also a list of the supplier's addresses so that you can make further enquiries.

Contributions

We are always on the lookout for good programs and articles for future issues of *ZX Computing*, and where better to look than to our own readers. If, when reading through the magazine, you think you can write programs as well, or better than, our present contributors, then let's hear from you.

All contributions are, of course, paid for at very competitive rates. So, if you've got your eye on a new ZX add-on or you'd just like to supplement your pocket money, get writing! It is vital, though, that all the programs you send to us are totally original, and not 'borrowed' or 'adapted' from other magazines or books. (When Tim Hartnell was sitting in the Editor's chair, he even received 'original' contributions he himself had written for his own books!)

Any kind of program (business, domestic, educational, or just fun) will be welcomed, but particularly those which use ZX BASIC in clever and efficient ways, or those which employ certain routines which can be re-used in other programs.

Program listings are vital, along with a clear explanation of how the program is constructed, what it does and what the user can expect to see once the program is RUN (a screen dump is particularly valuable in this respect). When submitting Spectrum programs, it is very important to remember to enclose a cassette of the program as well as the listing, as this will allow us to check the program before publication.

Lastly...

I wish you many hours of enjoyment with this magazine. And with that, it's now time for you to switch on your computer system and get down to the serious business of making the most of your micro with *ZX Computing*.

Roger Munford





Sound advice

Dear ZX Computing,
With regard to our program, Time-Gate, for the 48K ZX Spectrum, we have had a number of enquiries from customers telling us that the program crashes once LOADed. This may well be a fault on the ZX Spectrum and the way it deals with sound in machine code routines, rather than any fault with our software.

Thus, with each copy of Time-Gate, we are including the following paragraph as part of the instructions:

'The programs should RUN automatically once LOADed. If the program LOADs then crashes, then your Spectrum may be at fault and should be returned to Sinclair Research for examination. If this is the case, the crash will usually occur immediately, but on some machines, problems may only appear when they warm up. This problem will not generally show up on programs written in BASIC or small machine code programs which lack sound.'

Yours faithfully,

Quicksilva,
92 Northam Road,
Southampton,
SO2 0PB.



Extra, extra

Dear ZX Computing,
I have followed up your modification ideas for the game 'Swappo' as published in the first issue of ZX Computing. Here is a program listing of the original program plus my modifications.

My lowest score for this game is 6.

Yours faithfully,

Mark Colson,
Horncastle,
Lincs.

```
   1 LET F$=" "
   2 LET X=100
  10 DIM A(9)
  20 FOR Z=1 TO 9
  30 LET A=INT (RND*9)+1
  40 IF Z=1 THEN GOTO 80
  50 FOR J=1 TO Z-1
  60 IF A(J)=A THEN GOTO 30
  70 NEXT J
  80 LET A(Z)=A
  90 NEXT Z
  95 LET B=0
  97 PRINT AT 6,6;
 100 FOR S=1 TO 9
 110 PRINT A(S);
 120 NEXT S
 130 PRINT
 200 PRINT
 205 PRINT "ENTER NUMBER TO REVE
RSE, MOVE ";B+1
 207 PRINT AT 10,0;"             "
 210 INPUT J
 215 PRINT AT 8,0;"
 "
 220 IF J<1 OR J>9 THEN GOTO 210
 260 LET K=(J+1)/2
 270 FOR Z=1 TO K
 280 LET A=A(Z)
 285 LET A(Z)=A(J+1-Z)
 287 LET A(J+1-Z)=A
 290 NEXT Z
 295 LET B=B+1
 300 FOR Z=1 TO 9
 310 IF A(Z)<>Z THEN GOTO 97
 320 NEXT Z
 325 PRINT AT 6,6;"123456789"
 330 PRINT AT 8,0;"IT TOOK YOU "
B;" MOVES"
 331 IF B=X THEN GOSUB 600
 332 IF B>X THEN PRINT AT 10,0;"
BAD LUCK"
 335 IF B=X THEN PRINT AT 0,0;"L
OWEST SCORE",,,,F$,X,I$,X
 336 IF B<X THEN GOSUB 500
 337 IF B<=X THEN PRINT AT 0,0;"
LOWEST SCORE",,,,F$,X
 338 IF B<X THEN PRINT AT 0,0;"L
OWEST SCORE",,,,F$,X
 339 PRINT AT 20,0;"PRESS ANY KE
Y TO START AGAIN"
 340 PAUSE 4E4
 341 PRINT AT 6,6;"          ";A
T 8,0;"
       ";AT 10,0;"           "
 350 PRINT AT 20,0;"
 "
 360 GOTO 10
 500 PRINT
 505 LET X=B
 510 PRINT "YOUR SCORE IS THE LO
WEST","PLEASE ENTER YOUR NAME"
 520 INPUT F$
 530 CLS
 540 RETURN
 600 PRINT
 610 PRINT "YOUR SCORE IS THE SA
ME AS ";F$,"PLEASE ENTER YOUR NA
ME"
 620 INPUT I$
 630 CLS
 640 RETURN
```

The program listing of the original Swappo game plus Mark's modifications.



Anyone for bridge?

I wonder if any of your readers could help me with a ZX81 programming problem?

I am in the process of writing a bridge program which will allow the player to bid and play a game of bridge against the computer. The problem arises as follows.

It is easy enough to instruct the computer that if four people play, say, the 2, 3, 4 and 5 of Spades in a given trick, the 5 will win because it is the highest. What is much harder is to organise matters so that if the players play the Jack, Queen, King and Ace of a certain suit (represented by J, Q, K and A), the Ace will win the hand. In the language of Sinclair, seniority of letters are in alphabetical order; thus, Q is greater than K, K is greater than J, and J is greater than A.

What is required is a machine code routine which will re-arrange the alphabet in such a way that A is greater than K, K is greater than Q, and Q is greater than J. Because the 10 is the only card with two digits, this also needs to use a separate letter (with suitable seniority) to denote it.

If anyone is able to help me with this problem, I would be most grateful. There are, of course, many ways around this problem other than re-arranging the alphabet, but they take up rather a lot of memory space — can anyone help?
Yours faithfully,

R Wheen,
London W11.



Checkers cheating

Dear ZX Computing,
I've only had my ZX81 for three weeks now, but as soon as I bought my 16K RAM Pack I tried your 'Corner checkers' program in the October/November issue of ZX Computing.

I decided to sit down and write some additional lines to prevent anyone cheating. Here is an explanation of what the program does.

Line 7062 — Only allows you to move one of your pieces, and only to an empty square.
Line 7065 — Allows moves of one square only.
Line 7066 — Prohibits moves of more than two squares.
Line 7076 — Only allows moves of two squares if they are legitimate 'capture' moves.
Line 7199 — Necessary to return from the subroutine, but delete line 7900.

Here is my additional program.

```
7062 IF A(A) <> H OR A(B)
     <> E THEN GOTO
     7200
7064 LET Q = ABS(A - B)
7065 IF Q=9 OR Q=11
     THEN GOTO 7070
7066 IF Q > 22 THEN GOTO
     7200
7076 IF Q > 11 AND A
     ((A+B)/2)<> C THEN
     GOTO 7200
7199 RETURN
7200 PRINT AT 0,6;
     "CHEAT"
7210 PAUSE 100
7220 PRINT AT 0,0; "NOW
     TRY A LEGAL MOVE"
7230 PAUSE 100
7240 PRINT AT
     0,0;"                "
7250 GOTO 7010
```

Thanks for an entertaining magazine.
Yours faithfully,

Stephen Green,
Lenwade,
Norfolk.



Redesign required

Dear ZX Computing,
I think you may find the following interesting.

I recently bought a ZX81 and, after about a week, I splashed out yet more cash on what I thought was the best looking RAM pack, the Memotech model. After a number of 'phone calls, I found one in West Ealing and I went and bought it.

I got home, powered up the micro with the new RAM pack, and all I got was a picture covered in small rapidly moving dots. Twice I returned the RAM pack to the shop where I bought it and each time got the same picture.

Eventually I rang up Memotech in Oxford and spoke to a 'Technical Adviser' who told me that the strange display was due to a redesign by Sinclair Research in November 1982. He then told me to send my RAM pack back to Memotech and they would modify it to work with the new ZX81s.

I just wonder how many people have had a ZX81 for Christmas which was built after November 1982 and are having the same problem. I think Memotech should say something about this incompatibility thus stopping people like me from spending a fortune on transport fares to get one that works.
Yours faithfully,

G Shackleford,
Eastcote,
Middlesex.

● *I had word with a spokesperson from Memotech as soon as I received this letter and was told that the problem with the redesigned ZX81 and Memotech RAM packs has now been overcome. Memotech would like to offer their apologies for the inconvenience to any of their customers and would suggest that any RAM packs in need of modification should be sent directly to their offices. The address to send your RAM pack to, should it be incompatible to your ZX81, is:*

Memotech Ltd,
Witney,
Oxon OX8 6BX.



The bugs are biting...

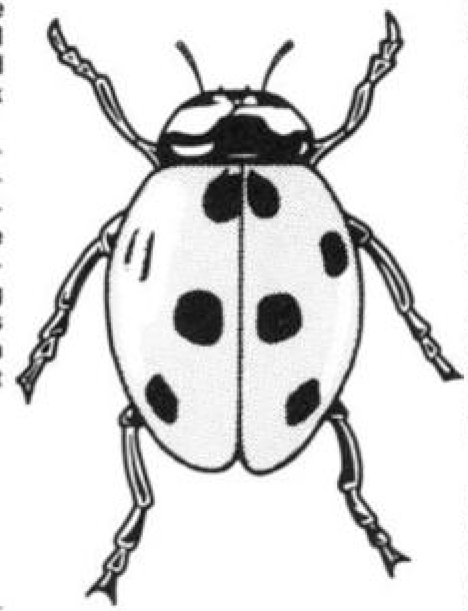
Dear ZX Computing,
I would like to advice you of an error in your Oct/Nov 1982 issue of ZX Computing. One of the lines of 'Ground to Air Missile' on page 41 was wrong.

Line 14 should have read:

```
14 LET Y=Y+(2=VAL"1")-
(X=VAL"0")
```

Hope this has been of help.
Yours faithfully,

Laurence Buckley,
County Cork,
Ireland.



And again...

Dear ZX Computing,
May I draw attention to an apparent mistake in an article in the Dec/Jan issue of ZX Computing.

On page 106, during an article on board games, my ZX81 does not seem to realise it has lost a piece unless I insert a line such as:

```
7132 LET A((10*(A1+B1)/2)+
     (A2+B2)/2) =CODE" "
```

Everything else now seems to work OK.
Yours faithfully,

B W Youngs,
Stonesfield,
Oxford.



Out of memory error

Dear ZX Computing,
Could you please tell your readers about a problem which can arise after using a machine code program on the ZX Spectrum.

If you attempt to LOAD a reasonably long program immediately afterwards, the title is printed onto the screen, followed by the message 'H out of memory, 0:1'. If the program does LOAD, it may crash with a similar message when it is being RUN. Machine code programs usually leave the Spectrum with the system variable RAMtop set to a relatively low value. Even after pressing New and Enter, the machine still believes that it is a 10K or 12K Spectrum.

The simplest solution is to turn off the power to the ZX Spectrum after RUNning your Chess, Space Invaders or Gulpman programs. When you turn the machine back on, the computer will once more have 16K or 48K of available memory.

Alternatively, use CLEAR 32599 or CLEAR 65367 to reset RAMtop, depending, of course, whether you have a 16K or 48K ZX Spectrum respectively.

This problem may well cause users to believe that a cassette or perfectly satisfactory software product is faulty. Ideally, there should be a warning notice on commercially available machine code programs pointing out that after their use, the ZX Spectrum will be left with temporary amnesia.
Yours faithfully,

Jeff Warrren,
Calpac Computer Software.



Fantasy Island

Dear ZX Computing,
I must inform you of my success! After only four days of playing 'Fantasy Games' (or more particularly, side two of the cassette from Psion Software — Sorcerer's Island), I actually managed to get off the island.

As I played the game more, I seemed to lose the urge to get off the island and acquired a need to explore and map the area instead. I have met the Dwarf King and the Grand Sorcerer, and explored the Dwarf's underground kingdom and the Sorcerer's castle (situated to the left and right of the lake respectively). I have achieved the rank of master-bone grade two (which is higher than grade one) mainly by fighting to get cash, bribing and resting frequently (which gives you back the valuable 10 life points you



Photograph courtesy of The Rank Organisation.

lose every time you move).

I found the game very absorbing, and, as I probably spent more time on the game than your reviewer, Nick Pearce, can I offer the following hint: when you leave the Dwarf's kingdom, ask for information!

I think that more information on the inlay card of the tape would have been welcome as I found most of the game had to be learned by trial and error.

Next time, Psion, more detail on the fantasy games, please.
Yours faithfully,

John Shiali,
London N19.

Fantasy island II

Dear ZX Computing,
I have just this evening read a review of Psion's Fantasy Games cassette in your magazine. I found the review well-written and I would like to reassure anyone who may have doubts about escaping from 'Sorcerer's Island' that it is indeed possible.

I would not like to give away the secrets of this work of art but for those in despair, I would like to offer a number of tips without giving the game away.

First, watch out for what you are carrying and anything that you may come across. The names of these items may seem wierd and have little meaning, but the right items are important and the names can provide useful hints as to their use. Also, watch out for the Balrog, the King of Dwarves and the Grand Sorcerer. They are not what they seem and if treated in the right way can become invaluable allies — however, treat them wrong and you will find them formidable foes.

Last of all, you may travel over the areas marked out as water given the right assistance, and when you come across the Ornate Golden Door, you are fairly near the exit.

I feel that knowledge of the above few points should assist any weary, frustrated adventurer in leaving the island without giving away too much.

Thank you, Psion, for your 'Fantasy Games', — I thoroughly enjoyed myself.
Yours faithfully,

Michael Carroll,
Wexford,
Ireland.

Printer problem

Dear ZX Computing,
Could any of your readers assist me with a problem. Can the ZX81 Printer be used with a +12V and +5V supply instead of the +9V and +5V supply?

My ZX81 has been much expanded, and the +12V is needed for the RAM. The ZX system I now have has become very complex and I would like to avoid the need to dismantle and install yet another regulator. I have written to Sinclair Research with this question but as yet have had no reply. I would much appreciate some help, as I am not happy using the printer until I am sure it will do no harm.
Your faithfully,

K Graham,
Blackpool,
Lancs.

A touch of the wobbles?

Dear ZX Computing,
Having bought a ZX81 with 16K RAM Pack for my 10 year old daughter six months ago. We have both suffered growing annoyance and frustration with 'wobble' and program crashes.

Hearty laughter ensued on reading the various suggested remedies in last month's edition of ZX Computing.

Opening the RAM Pack and prising the circuit boards apart! Skilled usage of 3/16" hardboard!

The price of 20th Century technology!

However we still intend to try these 'primitive' measures.
Yours faithfully,

R A and S J Hodge,
Belgravia,
London.



The winner...

Dear ZX Computing,
I felt I had to put pen to paper after I read Nick Pearce's review of 'Bomber', a software cassette from Psion.

In his review, Nick Pearce said that 'it is probably impossible to completely obliterate the city'. Well, my record is 1,010 points, which means that I have destroyed nearly five cities.

And, better than that, my brother is unmatchable with an unbelievable score of 2,632 which is nearly 13 cities destroyed. All these scores were achieved at speed nine. Our record for speed three is 588.
Yours faithfully,

Narinder Sahota,
Warley,
Birmingham.

Spectrum suggestions

Dear ZX Computing,
I'd like to take this opportunity to suggest a couple of couple of tips and ideas for the ZX Spectrum.

The Spectrum can write to files (or so the manual says) and indeed, without the Microdrives, that statements PRINT #, etc, can still be used. For example, try PRINT #2; "Fred". You will see that channel 2 is the top half of the screen.

Now try PRINT #3;(statement) or LIST #3;(line number) and you will see that the channel 3 is the printer. Thus, the two examples are equivalent to LPRINT(statement) and LLIST (line number).

Finaly, channels 0 and 1 (the same channel as far as I can tell) is the bottom half of the screen. Thus, PRINT #1;(statement) prints a statement to the bottom half of the screen.

I hope you and your readers find this information useful.
Yours faithfully,

John Miller,
Farlington,
Portsmouth.

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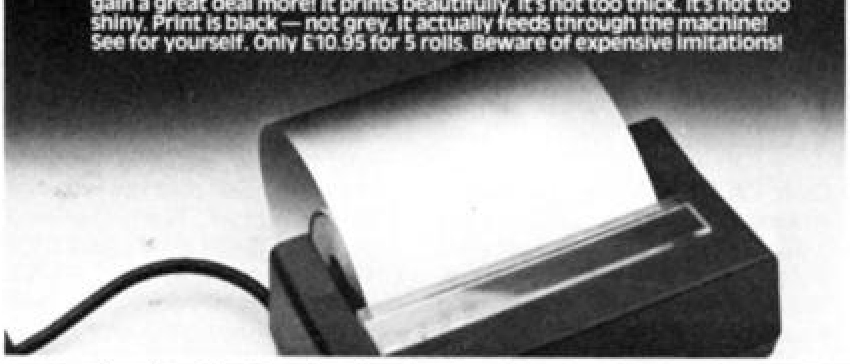
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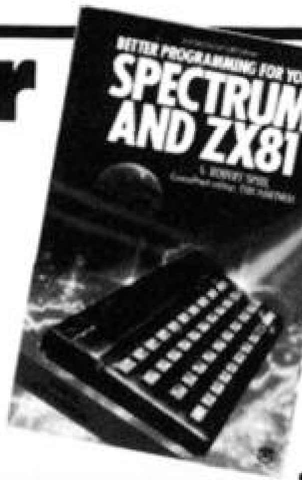
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Better programming



A book entitled 'Better Programming For Your Spectrum And ZX81' hit the bookshops last month. Here we give you a sneak preview of two of the programs featured in this new publication written by Robert Speel.

Although the two programs featured here are both essentially games programs, the book also contains several more serious programs. The text begins with a look at Spectrum colour and sound, with chapters on user-defined characters and the use of high resolution graphics.

Program examples are provided throughout and all the techniques utilized within the longer programs are explained within the text. Programs are included for both the Spectrum and the ZX81, with a useful chapter on converting programs for the ZX81 so that they will run on the Spectrum.

The following two programs are good examples of the type of programming material included within Robert Speel's new book — Knight Flight has been written for the 16K ZX Spectrum and Alien Descender requires 2.5K to run on a ZX81.

Knight flight

This game involves a fight between two knights.

You control a white knight, and the computer has a black knight. At the start, you have to select armour and weapons for your knight. You have 100 gold coins to spend, which means you cannot have the heaviest armour and lance and the best weapons too.

A mace is the strongest attacking weapon, a sword the weakest. However, a sword is useful in defence as well as attack, whereas an axe or mace is not.

Once you have chosen your weapons, the enemy's choice is announced. The fight then begins.

At first, the knights joust on horseback until one knight is knocked off his horse. Apart from your choice of lance and armour, you have no control over the jousting. Once one knight is unhorsed, the other will dismount and the fight continues on foot.

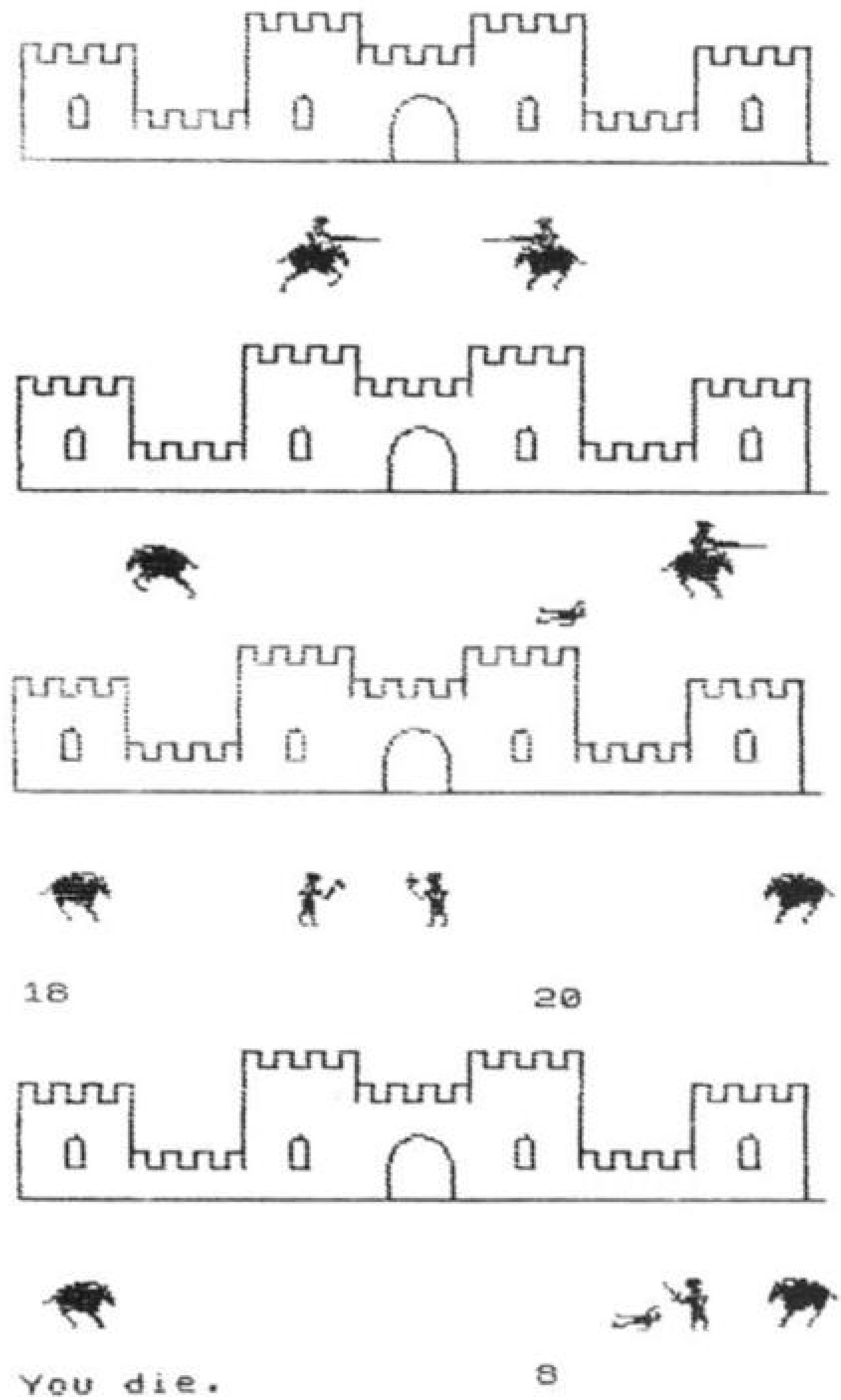
You attack the opponent knight by moving near to him using the keys 5 and 8 to move. You 'hit' by pressing one of the keys 1, 2, 3 or 4 — the number determining the strength of hit. Each time you hit, your strength, shown at the bottom left of the screen goes down by that number. If your strength reaches zero, you die. By moving away from the enemy, you can gradually recover your strength up to your maximum.

A successful hit on the enemy lowers his strength by one *permanently*. The enemy strikes you in exactly the same way. This means that fighting consists of rushing up to your opponent, hitting at him a few times, then retiring to recover from your exhaustion. It is essential that you keep an eye on your own strength to know when to retreat. Gradually, your maximum strength will be depleted (and so, hopefully, will your opponent's) until one or the other, with a strength of three or less, cannot strike properly. Death for the weaker usually follows quickly.

Notes on the listing

This is rather a long game which occupies nearly all of the basic 16K Spectrum. Due to the large numbers of user-defined graphics, the use of CHR$ 144, etc, has been dropped, and graphics characters are used in the listings. All capital letters inside quotes should be graphic letters, ie, you must go into graphics mode, *then* press the letter. If you forget one or two, you may see knights charging around on the backs of ABC creatures. If this occurs, BREAK the program, find the letter, and replace it with a graphic letter.

Lines	Action
10	GOSUB start routine, buy weapons and set up user-defined graphics.
100-110	Basic 'charge on horseback' routine. Graphics ABC and LKJ are the horses, DEF/GHI and ONM/RQP are alternate sets of legs to give a galloping effect. In lines 100 and 130, the underline character is used (Symbol Shift 0) as the point of a lance, US and TU are the rest of the lance and the knight.
160	Gives a simulation of the sound of horses' hooves, which sounds very good when amplified.
170	Deals with a possible crash between the two knights.
180	Checks if the knights are about to go off screen.
200-910	Cope with what happens when the knights meet on horseback.
200-240	Is the actual hit, strengths of opponents being calculated to take in armour, lance-type and shields.
500-540	Show the left knight falling off.
600-840	Show the right knight falling off.
800-840	Check if a knight has fallen off at the end of a run.
900-910	Deal with turning at the end of a run when neither knight is knocked off his horse.
1000-1040	Turn horses round at end of run when one man is down; and dismounts other knight.
1100-1430	Foot-fighting loop.
1100	PRINTs two knights with correct weapons.
1120	Moves your knight.
1130	Moves opponent's knight, including automatic retreat when strength below 3.
1200-1260	Your knight hits opponent if in range.
1300-1320	Enemy hits you. Your hits and your opponent's depend for their success on the strength of hit (1-4), the weapon's attack value (1-3), its defence value if it is a sword, armour and shields, if any, together with a random attack value. When all these are added, the hit is judged successful or unsuccessful.
1330-1340	If your current strength is larger than your maximum strength, then let current strength = maximum strength.
1400-1430	If knights are a distance apart, then they can gradually recover to their current maximum strength
4000-4010	You die.
4500-4510	Enemy dies
7000-7280	Start of game. You choose your weapons and armour, from list giving prices. Note improper entries will be ignored.
7320-7460	Enemy chooses weapons. Either enemy chooses to have a strong attack or a strong defence.
8000-8500	DRAW castle in background and start fight.
9000-9130	DATA for user-defined graphics used for knights, horses and weapons.



Some sample screen dumps from the program, Knight Flight.

```
   1 REM Knight Fight
   2 REM  © S.Robert Speel 1982

  10 PAPER 4: BORDER 4: CLS : GO
 SUB 7000

 100 INK ec: IF eh=1 THEN PRINT
AT y-1,x-1;"_US "
 110 PRINT AT y,x;"ABC ": IF x/2
=INT (x/2) THEN PRINT AT y+1,x;"
DEF "
 120 IF x/2<>INT (x/2) THEN PRIN
T AT y+1,x;"GHI "
 130 INK ac: IF ah=1 THEN PRINT
AT y-1,29-x;" TU_"
 140 PRINT AT y,28-x;" LKJ": IF
x/2=INT (x/2) THEN PRINT AT y+1,
28-x;" ONM"
 150 IF x/2<>INT (x/2) THEN PRIN
T AT y+1,26-x;" RQP"
 160 LET x=x-1: BEEP .003,10: PA
USE 2: BEEP .003,5: PAUSE 3: BEE
P .003,0: PAUSE 5
 170 IF x=16 AND ec=7 THEN GO TO
 200
 180 IF x<2 THEN GO TO 800
 190 GO TO 100

 200 LET ad=le+INT (RND*6)-ar-(a
r=2)-INT (RND*6): LET ed=la+INT
(RND*4)-er-(er=2)-INT (RND*4)
 210 IF ad<=0 AND ed<=0 THEN GO
TO 100
 220 IF ad>0 AND ed>0 THEN GO TO
 500+100*(ad>ed)
 230 IF ad>0 THEN GO TO 600
 240 GO TO 500

 500 PRINT AT y-1,x-4;" T/\": BE
EP .1,50: BEEP .1,30
 510 PRINT AT y-1,x-4;"   ": BEEP
 .1,20: BEEP .1,10
 520 RESTORE 9100: FOR f=0 TO 1:
 FOR g=0 TO 7: READ a: POKE USR
CHR$ 163+g,a: NEXT g: PRINT AT y
+1,x-6+f;CHR$ 163;: NEXT f
 530 PRINT "              ";AT y,x+3;"
 ";AT y,28-x;"  "
 540 LET x=x-1: LET ex=x+9: LET
y=y-1: LET ah=0: LET em=em-INT (
RND*6)-1: LET se=se-6: GO TO 100

 600 PRINT AT y-1,x;"/\S": BEEP
.1,50: BEEP .1,30
 610 PRINT AT y-1,x;"          ": B
EEP .1,50: BEEP .1,30
 620 INK 7: RESTORE 9100: FOR f=
0 TO 1: FOR g=0 TO 7: READ a: PO
KE USR CHR$ 162+g,a: NEXT g: PRI
NT AT y+1,x+4+f;CHR$ 162;: NEXT
f
 630 PRINT AT y+1,x-4;"           "
;AT y,x+3;"  ";AT y,28-x;"  "
 640 LET x=x-1: LET ex=x+9: LET
y=y-1: LET eh=0: LET am=am-INT (
RND*4): LET sa=sa-5: GO TO 100

 800 IF eh=1 AND ah=1 THEN GO TO
 900
 810 LET x=20: LET ex=10: LET y=
y+1
 820 IF eh=1 THEN LET x=5
 830 IF ah=1 THEN LET ex=25
 840 GO TO 1000

 900 PRINT AT y-1,x;"        ";AT y-
1,28-x;"      "
 910 LET x=26: LET y=10: LET dc=
ac:: LET ac=ec: LET ec=dc: GO TO
 100

1000 PRINT AT y-1,0;" ";TAB 31;"
 "; INK 7;AT y,0;" LKJ"; INK 0;T
AB 28;" ABC"; INK 7;AT y+1,0;" O
NM"; INK 0;AT y+1,28;" GHI"
1010 FOR f=1 TO 2: PRINT AT y-f,
0;"     ";AT y-f,27;"      ": NEXT
f
1020 RESTORE 9060: FOR f=1 TO 2:
 FOR g=0 TO 7: READ a: POKE USR
CHR$ (143+f)+g,a: NEXT g: NEXT f
1030 RESTORE 9100: FOR f=3 TO 12
: FOR g=0 TO 7: READ a. POKE USR
 CHR$ (143+f)+g,a: NEXT g: NEXT
f
1040 PRINT AT y+1,5;"
            "

1100 PRINT INK 0;AT y,ex;v$;"A "
;AT y+1,ex;" E "; INK 7;AT y,x-1
;"  B";w$;AT y+1,x-1;"  F "
1110 IF ex>x+2 THEN PRINT AT y,e
x-1;" ";AT y,x+3;"  "
1120 LET x=x+(INKEY$="8")-(INKEY
$="5")+(x<6)-(x>25): LET x=x-(x>
ex-2)
1130 LET ex=ex+SGN (-(ex>x+1 AND
 RND<.5)+(ex<5)-(ex>25)+(RND<.3)
+(se<3 AND ex<25)): IF ex-x>2 TH
EN GO TO 1400

1200 LET a$=INKEY$: IF a$<"1" OR
 a$>"4" THEN LET a$="0"
```

```
1210 LET ez=INT (RND*4)+1: IF se
<ez THEN LET ez=se-1
1220 IF se<3 THEN LET ez=0
1230 IF a$="0" THEN GO TO 1300
1240 LET sa=sa-VAL a$: IF sa<1 T
HEN GO TO 4000
1250 IF VAL a$+wa+(RND*7)+1>ez+e
s+er-1+(we=1) THEN LET em=em-1
1260 IF em<1 THEN GO TO 4500

1300 BEEP .03,45: LET se=se-ez
1310 IF ez+we+INT (RND*3)>VAL a$
+sh+ar+(wa=1) THEN LET am=am-1
1320 IF am<1 THEN GO TO 4000
1330 IF sa>am THEN LET sa=am
1340 IF se>em THEN LET se=em

1400 PRINT AT 20,0;sa;" ";AT 20,
20;se;" ": IF ex-x<3 THEN GO TO
1100
1410 FOR f=1 TO 2: IF sa<am THEN
 LET sa=sa+1: NEXT f
1420 IF se<em THEN LET se=se+1
1430 GO TO 1100

4000 PRINT INK 0;AT y,x;"   ";v$
;"A ": INK 7;AT y+1,x;" CD"; INK
 0;" E "
4010 PRINT AT 20,0;"You die.": S
TOP

4500 PRINT INK 7;AT y,x;"  B";W$
;"  ";AT y+1,x;"  F "; INK 0;"CD
"

4510 PRINT AT 20,20;"He dies.":
STOP

7000 PRINT "Knight Fight"''

7050 RANDOMIZE : LET ah=1: LET e
h=1: LET x=26: LET y=10
7060 LET cash=100: LET sh=0: LET
 ac=0: LET ec=7

7100 PRINT '"(1) Chain-mail cost
s 40 coins,"'"(2) plate-mail 50.
"
7110 PRINT '"(1) Light  lances c
ost 10"'"(2) medium lances 20"'"
(3) heavy  lances 30."
7120 PRINT '"(1) Swords cost 20"
'"(2) axes 20"'"(3) maces 30."'"
Shields 20."
7130 FOR f=1 TO 21: FOR g=0 TO 7
: READ a: POKE USR CHR$ (f+143)+
g,a: NEXT g: NEXT f

7200 PRINT AT 21,0;"What armour
do you buy?": LET a$=INKEY$: IF
a$<"1" OR a$>"2" THEN GO TO 7200
7210 BEEP .5,0: LET ar=VAL a$: L
ET cash=cash-30-10*ar
7220 PRINT AT 21,0;"What lance d
o you buy? ": LET a$=INKEY$: IF
a$<"1" OR a$>"3" THEN GO TO 7220
7230 BEEP .5,0: LET la=VAL a$: L
ET cash=cash-10*la
7240 PRINT AT 21,0;"What other w
eapon do you buy?": LET a$=INKEY
$: IF a$<"1" OR a$>"3" THEN GO T
O 7240
7250 BEEP .5,0: LET wa=VAL a$: L
ET w$=CHR$ (152+wa): IF cash-20-
10*(wa=3)<0 THEN GO TO 7240
7260 LET cash=cash-10-10*(wa=3):
 IF cash<20 THEN GO TO 7300
7270 PRINT AT 21,0;"Do you buy a
 shield? (y/n)  ": LET a$=INKEY$
: IF a$<>"y" AND a$<>"n" THEN GO
 TO 7270
7280 BEEP .5,0: LET cash=cash-20
*(a$="y"): LET sh=(a$="y")

7320 LET sa=25: LET se=20: LET a
m=25: LET em=20

7360 CLS : PRINT ''"Your opponen
t chooses:-"''
7370 GO TO 7400+INT (RND*2)*50

7400 PRINT "Defence: Medium armo
ur."''"Attack: Heavy lance and a
 mace."
7410 LET er=2: LET es=0: LET we=
3: LET le=3: LET v$="I": GO TO 8
000

7450 PRINT "Defence: Heavy armou
r and shield"''"Attack: Medium l
ance and sword."
7460 LET er=2: LET es=1: LET we=
1: LET le=2: LET v$="G"

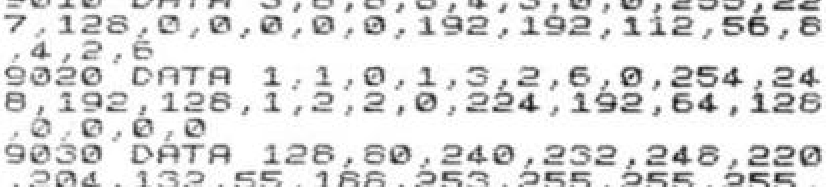
8000 PRINT ''"(Press ENTER to st
art)": PAUSE 0: CLS
8010 PLOT 0,120: DRAW 250,0: PLO
T 0,120: DRAW 0,30: GO SUB 8500
8020 DRAW 0,-20: GO SUB 8500: DR
AW 0,30: GO SUB 8500
8030 DRAW 0,-10: GO SUB 8500: DR
AW 0,10: GO SUB 8500
8040 DRAW 0,-30: GO SUB 8500: DR
AW 0,20: GO SUB 8500: DRAW 0,-30
8050 PLOT 115,120: DRAW 0,10: DR
AW 20,0,-PI: DRAW 0,-10
8060 FOR f=15 TO 230 STEP 70: PL
OT f,130: DRAW 5,0: DRAW 0,7: DR
AW -5,0,PI: DRAW 0,-7: NEXT f: G
O TO 9000

8500 FOR f=1 TO 3: DRAW 0,5: DRA
W 5,0: DRAW 0,-5: DRAW 5,0: NEXT
 f: DRAW 0,5: DRAW 5,0: DRAW 0,-
5: RETURN

9000 DATA 1,10,15,23,31,59,51,33
,236,61,191,255,255,255,255,255,
0,128,224,240,248,244,243,224
9010 DATA 3,6,8,8,4,3,0,0,255,22
7,128,0,0,0,0,0,192,192,112,56,8
,4,2,6
9020 DATA 1,1,0,1,3,2,6,0,254,24
8,192,128,1,2,2,0,224,192,64,128
,0,0,0,0
9030 DATA 128,80,240,232,248,220
,204,132,55,166,253,255,255,255,
255,255
9040 DATA 0,1,7,15,31,47,207,7,1
28,128,0,128,192,64,96,0,127,31,
3,1,128,64,64,0,7,3,2,1,0,0,0,0

9050 DATA 192,96,16,16,32,192,0,
0,255,199,1,0,0,0,0,0,3,3,14,28,
16,32,64,96
9060 DATA 120,248,112,56,40,246,
214,116,30,31,14,28,20,111,107,4
8,0,0,0,0,0,0,255,255

9100 DATA 0,0,32,63,0,71,120,0,3
,4,9,251,255,248,8,240
9110 DATA 60,60,60,60,54,34,34,1
02,60,60,60,60,108,68,68,54
9120 DATA 0,64,32,16,10,4,10,3,0
,0,48,112,72,8,4,3,16,24,60,24,1
6,8,4,3
9130 DATA 0,2,4,8,80,32,80,192,0
,0,12,14,18,16,32,192,8,24,60,24
,16,32,64,192
9140 RETURN
```



Alien descender

One lonely alien survived the attack on Earth and landed in the Pacific Ocean. It began to sink down a narrow gorge in the depth of the sea. How long can you, controlling the alien, keep it alive and avoid crashing into the rocky walls of the gorge?

The alien has one weapon which can destroy anything directly below its feet. But this does not protect its 'wings'. Every now and again, trails of bombs are launched from below (inverse asterisks). These can be destroyed by the alien's weapon, or avoided. If they hit the alien, it is destroyed. There are also larger depth charges, shaped like this:


DEPTH CHARGE


BOMB

To destroy a whole depth charge, the alien must be centred exactly above it.

The object is to survive as long as possible.

Use keys 5 and 8 to move left and right respectively and 6 to shoot at the area directly below the alien's feet. At the end, when your alien is destroyed, your score (number of goes survived) is given, along with the current 'highscore'. You are then offered another game.

Remember that as the alien is under water, its reactions are rather sluggish. It moves half a second or so after you press the movement key. If you hold down a key too long, the alien may well blunder onto one wall of the gorge. Naturally, as the alien descends, the gorge gets gradually narrower.

Lines	Action
10-60	Variables. HI = highscore; A = X co-ordinate of alien; GO = goes; A$ = space between walls of gorge; RS = co-ordinate of bomb, if any; X = X co-ordinate of left side of gorge.
100-150	Print converging walls to straight gorge, so that the alien cannot escape to left or right of gorge.
200	Beginning of main loop. Prints left side of gorge, space length A$ (initially 10 squares, gradually decreases) then right-hand side of gorge.
210	Changes X by 1 or not all. This makes the gorge zigzag from side to side randomly.
220	Prints alien. Note that his arms stretch up when you move.
230-270	PEEK at contents of squares directly under alien and if a bomb, wall or depth charge is there (ie, not all spaces or newline characters) then GOTO end of program.
300	Changes X co-ordinate of alien according to key pressed. Note that putting this line here gives the delayed reaction to commands.
310	Increases goes survived.
320	Occasionally decreases A$, ie, makes the gorge narrower. Note that the minimum size still may let the alien through. Alter this as desired. If LEN A$ is larger, then it is easier.
330	Occasionally prints depth charge on bottom line. As the frequency depends on LEN A$, more depth charges appear as the gorge gets narrower. Change this line to make depth charges more or less frequent as desired.
400-430	If there is a bomb trail, increase RS randomly and print a new bomb. Start a new bomb trail if RND .1. (Change this to make bombs more or less frequent, or perhaps dependent on LEN A$.) If bombs too far right, stop bomb trail. If bomb trail started, print current bomb. Note that as bombs may be shown to the left of the gorge, some advance warning is given. If you do not wish bombs outside the gorge, change line 430 to: 430 IF RS>LEN A$ THEN, etc
500	Scrolls up screen to give idea that alien is moving downwards.
600	If 6 key pressed, blows up anything directly beneath feet of alien. Note that this does not protect the whole underside of the alien, just the middle squares.
610	Re-does main loop.
1000-1210	Alien destroyed, made to flash on and off, score and 'highscore' printed. Screen cleared and new game offered.

```
   1 REM ALIEN DESCENDER
   2 REM       COPYRIGHT 1982
               S.ROBERT SPEEL
  10 LET HI=0
  20 LET A=10
  30 LET GO=0
  40 LET A$="                    "
  50 LET RS=0
  60 LET X=7
  70 RAND

 100 FOR F=0 TO 7
 110 PRINT AT F,F;"▒";TAB 27-F;
"▒"
 120 NEXT F
 130 FOR F=8 TO 21
 140 PRINT AT F,7;"▒";TAB 19;"▒
▒"
 150 NEXT F

 200 PRINT AT 21,X;"▒";A$;"▒"
 210 LET X=X+INT (RND*3)-1-(X=15
)+(X=0)
 220 PRINT AT 0,A;" ▄▄ ";AT 1,A;
"█▀▀█";AT 2,A;" ▄▀▄";AT 3,A;
 230 LET L=PEEK (PEEK 16398+256*
PEEK 16399)
 240 LET L=L+PEEK (1+PEEK 16398+
256*PEEK 16399)
 250 LET L=L+PEEK (2+PEEK 16398+
256*PEEK 16399)
 260 LET L=L+PEEK (3+PEEK 16398+
256*PEEK 16399)
 270 IF L>0 AND L<>236 THEN GOTO
 1000

 300 LET A=A+(INKEY$="8")-(INKEY
$="5")
 310 LET GO=GO+1
 320 IF RND<.025 AND LEN A$>6 TH
EN LET A$=A$(2 TO )
 330 IF RND<1/LEN A$ THEN PRINT
AT 21,X+RND*LEN A$;"▄█▄"

 400 IF RS>0 THEN LET RS=RS+RND*
7
 410 LET RS=RS+(RND<.1)
 420 IF RS>LEN A$+X THEN LET RS=
0
 430 IF RS>0 THEN PRINT AT 21,RS
;"█"
 500 SCROLL

 600 IF INKEY$="6" THEN PRINT AT
 3,A+1;"==";AT 3,A+1;"▄▄";AT 3,A
+1;"  "
 610 GOTO 200

1000 FOR F=1 TO 10
1010 PRINT AT 0,A;" ▄▄ ";AT 1,A;
"█▀▀█";AT 2,A;" ▄▀▄"
1020 PRINT AT 0,A;"    ";AT 1,A;"
    ";AT 2,A;"    "
1030 NEXT F

1050 PRINT AT 20,0;"YOUR SCORE I
S ";GO
1060 IF GO>HI THEN LET HI=GO
1070 PRINT AT 21,2;"HISCORE = ";
HI
1080 FOR F=1 TO 200
1090 NEXT F
1100 CLS
1110 PRINT "ANOTHER GAME? (Y/N)"
1120 IF INKEY$="Y" THEN GOTO 20
1130 IF INKEY$="N" THEN STOP
1210 GOTO 1120
```

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Air raid



Run for cover — here comes a smashing program from Stephen Ormrod of Bury.

In this program, Stephen has taken trouble to incorporate moving graphics, simple rules and an emphasis on strategy rather than relying on Lady Luck. Indeed, it took seven versions of the program before Stephen was happy enough to send it to us!

The rules of the game are quite simple. You begin the game with 30 bombs for your skycraft and you can release a bomb by pressing the 'O' key. Your aim is to hit all the enemy ships and 'planes you can within the restriction of how many bombs you have. If a ship reaches the landing stage before you can destroy it you will lose one of your valuable bombs, and you are further restricted by only being able to fire one bomb at a time (if there is a bomb still on-screen, you will not be allowed to fire another).

Plain sailing?

When you first RUN the program, the Score Advance Table will appear on the screen. From this you will be able to see that ships are more valuable (in terms of how many points are scored) to destroy than 'planes. The aircraft are not easy to hit — but there is no penalty for allowing a 'plane to escape your fire.

After pressing the 'S' key, the score table is erased and you should get your finger over the 'O' key — this is the only control key used in the game. Your ammunition will appear as a series of 'grated railings' at the top of the screen. The sea will appear at the bottom of the screen with a landing stage in the bottom right-hand corner. You are positioned in a skycraft, sited just below your ammunition dump at the top of the screen.

Your skycraft slowly 'circles' the sea harbour — you travel across the screen from right to left, and when you disappear on the left-hand side you miraculously appear on the right-hand side again. The white speck in the centre of your skycraft indicates that you have a bomb on board.

Ships will appear on the left-hand side of the screen and slowly move toward the landing stage. As you move across the screen in your skycraft, you must decide when to release your bomb in order to destroy the ship. If you manage to score a direct hit on the ship, you will be rewarded with the ship being swallowed up by the mysterious deep. However, if you miss the ship, the bomb will explode harmlessly in the sea and the ship will dock at the landing stage, its troops will disembark unopposed and steal one of your bombs.

Periodically, an enemy 'plane will fly across the screen from left to right, moving twice as quickly as their naval colleagues. They are not trying to reach the landing stage, their object is to get between you and the ships, thus blocking your bomb. There will only ever be one ship or one 'plane visible on the screen at any time, but a 'plane and a ship may be seen together.

A shot in the dark

One of the problems you will encounter is judging when to release your bombs so that they will destroy the ships. One tactic you could employ is the 'shot in the dark' option in which you release a bomb before a ship has yet come onto the screen. But



remember, you have only 30 bombs, so it's best to make them count.

When you have used up your 30 bombs, the display will scroll upwards so that the 'sea' ends up at the top of the screen. The score you have achieved during the game is then displayed, followed by the top highest scores of the day. The sea will then begin rolling again and the ZX81 will wait for you to press '0' signifying that you would like another game.

To help you decipher the program listing, perhaps the following would be useful. The ships and aircraft are held in string arrays, A$, B$ and C$. Cruisers, represented by A$, are generated as follows:

A$(1) — "Space, Graphic 8, Graphic 4, Space"
A$(2) — "Space, Graphic 8, Graphic 5, Space"
A$(3) — "Graphic R, Inverse Space, Inverse Space, Graphic E"

B$ is used to represent the aircraft and is comprised of the following:

B$ — "Graphic 7, Graphic 7, Graphic 6, Graphic E"

Battleships are held in C$ and are made up as below:

C$(1) — "2 Spaces, Graphic 3, Graphic 5, 2 Spaces"
C$(2) — "2 Spaces, Graphic 8, Graphic 5, 2 Spaces"
C$(3) — "Graphic Y, Graphic 6, Graphic Q, Graphic W, Graphic 6, Graphic T"
C$(4) — "Space, Graphic R, 2 Inverse Spaces, Graphic E, Space"

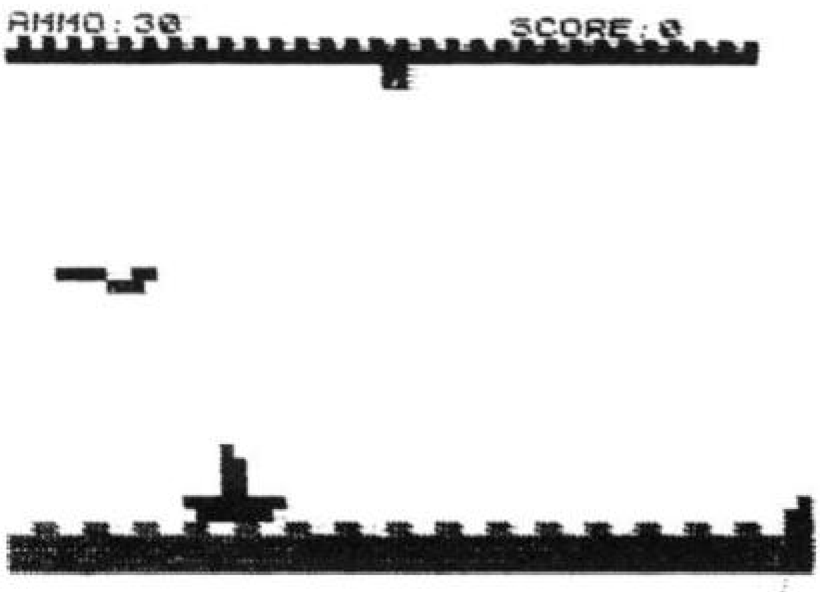
The ammunition dump is generated in line 134 and comprises 30 Graphic Qs. The string array, D$, is your skycraft and is shown in line 135 as an Inverse Dot and a Space. Line 150 is made up of 31 Graphic As and one Inverse Space.

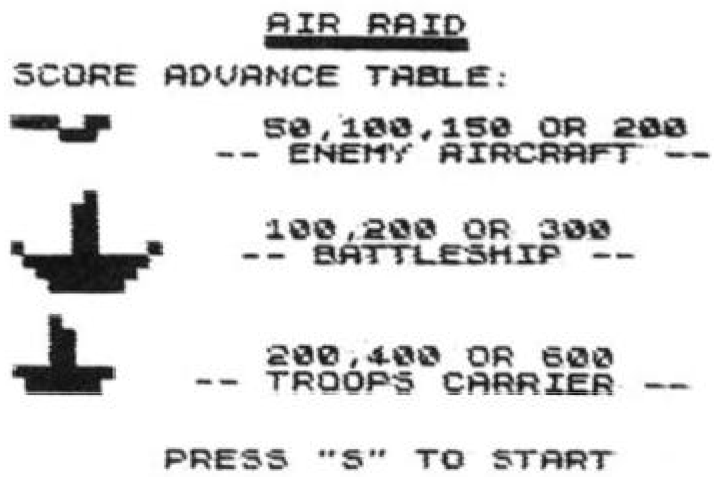
E$ and F$ are alternating Graphic As and Graphic Ds ending in an Inverse Space. Note that E$ and F$ run in antiphase and alternate in subroutines in lines 7000 and 7020 to make the wave-like motion of the sea.

Lines 200-270 represent the 'core' of the program. The rest of the listing comprises a number of routines which are called from time to time from the main program. Try working out what does what.

Here is a list of variables used in the program to help you work out how the program works.

- Array V(6) — The six best scores.
- Array V(3) — Whether or not a 'plane or ship is visible.
- SC — Player's score.
- F — Flag controlling whether or not a bomb is loaded aboard your aircraft.
- YU — Position of waves on the sea.
- PO — Position of last ammunition in the dump.
- AMM — The number of bombs left (plus one).
- X — The horizontal position of the skycraft.
- Y — The horizontal line of the falling bomb.
- AS — The controlling variable for what will appear on the screen next.
- L — Control variable in loops.
- N — Control variable in loops.
- SB — Individual score awarded for hitting a ship or 'plane.





Some sample screen dumps from the program.

```
  30 DIM U(6)
  40 SLOW
  50 DIM U(3)
  60 LET YU=20
  70 LET SC=0
  80 LET F=0
  85 DIM A$(3,4)
  90 LET A$(1)="    "
  95 LET A$(2)="    "
 100 LET A$(3)="    "
 105 LET B$="    "
 110 DIM C$(4,6)
 115 LET C$(1)="      "
 120 LET C$(2)="      "
 125 LET C$(3)="      "
 130 LET C$(4)="      "
 133 GOSUB 6000
 134 PRINT AT 1,0;""
 135 LET D$="  "
 136 LET PO=29
 137 GOSUB 1020
 140 LET X=25
 145 IF U(1)<>0 THEN PRINT AT 0,
9;"HI=";U(1)
 150 PRINT AT 21,0;""
 160 LET E$=""
 170 LET F$=""
 180 LET AMM=31
 190 GOSUB 1000
 195 PRINT AT 19,31;" "
 200 GOSUB 7000
 210 GOSUB 1110
 220 IF INKEY$="0" AND F=0 THEN
GOSUB 1500
 230 IF INT (RND*6)=0 THEN GOSUB
2000
 235 GOSUB 7020
 240 FOR N=1 TO 3
 250 IF U(N)<>0 THEN GOSUB 2000+
(N*250)
 260 NEXT N
 270 IF F<>0 THEN GOSUB 3500
 275 GOTO 200
1000 PRINT AT 0,0;"AMMO:";AMM-1;
" "
1010 RETURN
1020 PRINT AT 0,20;"SCORE:";SC
1030 RETURN
1110 LET X=X-1
1115 PRINT AT 2,0;CHR$ 0
1120 IF X=-1 THEN LET X=28
1130 PRINT AT 2,X;D$
1140 RETURN
1500 LET F=2
1502 PRINT AT 1,PO;" "
1503 LET PO=PO-1
1505 LET AMM=AMM-1
1507 GOSUB 1000
1510 LET D$=" "
1515 LET Y=X
1520 RETURN
2000 LET AS=INT (RND*3)+1
2003 IF AS=3 AND U(1)<>0 OR AS=1
 AND U(3)<>0 THEN RETURN
2005 IF U(AS)=0 THEN LET U(AS)=2
2010 RETURN
2250 PRINT AT 17,U(1)-1;CHR$ 0;A
$(1)
2260 PRINT TAB U(1)-1;CHR$ 0;A$(
2)
2270 PRINT TAB U(1)-1;CHR$ 0;A$(
3)
2280 LET U(1)=U(1)+1
2290 IF U(1)<29 THEN RETURN
2300 LET U(1)=0
2310 PRINT AT 17,28;"     "
2320 PRINT TAB 28;"     "
2330 PRINT TAB 28;"     "
2335 GOSUB 3000
2340 RETURN
2500 PRINT AT 10,U(2)-2;"  ";B$
2510 LET U(2)=U(2)+2
2520 IF U(2)<29 THEN RETURN
2530 LET U(2)=0
2540 PRINT AT 10,28;"     "
2550 RETURN
2750 PRINT AT 15,U(3)-1;CHR$ 0;C
$(1)
2760 PRINT TAB U(3)-1;CHR$ 0;C$(
2)
2770 PRINT TAB U(3)-1;CHR$ 0;C$(
3)
2780 PRINT TAB U(3)-1;CHR$ 0;C$(
4)
2790 LET U(3)=U(3)+1
2800 IF U(3)<27 THEN RETURN
2810 LET U(3)=0
2820 PRINT AT 16,26;"       "
2830 FOR N=1 TO 3
2840 PRINT TAB 26;"       "
2850 NEXT N
3000 FOR L=18 TO 1 STEP -1
3002 PRINT AT L,31;" ";AT L+1,31
;" "
3004 NEXT L
3005 FOR L=30 TO PO STEP -1
3006 PRINT AT 1,L;" "
3007 NEXT L
3008 LET PO=PO-1
3010 LET AMM=AMM-1
3020 GOSUB 1000
3022 FOR L=PO+1 TO 30
```

```
3023 PRINT AT 1,L;" ▟"
3025 NEXT L
3026 PRINT AT 1,31;"▟"
3027 FOR L=2 TO 19
3028 PRINT AT L,31;"▟";AT L-1,31
;" "
3030 NEXT L
3035 IF AMM=1 THEN GOTO 9000
3040 RETURN
3500 LET F=F+1
3505 PRINT AT F,Y;"."
3510 PRINT AT F-1,Y;CHR$ 0
3520 IF F=10 THEN GOTO 4000
3530 IF F<19 THEN RETURN
3540 IF U(1)<>0 THEN GOTO 4500
3550 IF U(3)<>0 THEN GOTO 5000
3555 IF PO=-1 THEN GOTO 9000
3560 IF F=19 THEN RETURN
3570 IF Y>26 THEN PRINT AT 20,Y-
4;"SPLASH"
3580 IF Y<27 THEN PRINT AT 20,Y;
"SPLASH"
3590 LET D$="█ "
3595 IF PO=-1 THEN GOTO 9000
3600 LET F=0
3610 RETURN
4000 FOR N=-2 TO 1
4010 IF Y=U(2)+N THEN GOTO 4100
4020 NEXT N
4030 RETURN
4100 FOR N=1 TO 15
4105 PRINT AT 10,U(2)-2;"BOOM"
4110 PRINT AT 10,U(2)-2;"BOOM"
4130 NEXT N
4140 LET SB=INT (RND*4+1)*50
4150 PRINT AT 10,U(2)-2;SB;"   "
4160 LET SC=SC+SB
4170 GOSUB 1020
4180 PRINT AT 10,U(2)-2;"     "
4185 LET U(2)=0
4190 GOTO 3590
4500 FOR N=-1 TO 2
4510 IF Y=U(1)+N THEN GOTO 4600
4520 NEXT N
4530 GOTO 3560
4600 LET U$="     "
4610 PRINT AT 17,U(1)-1;U$
4620 GOSUB 7020
4640 PRINT AT 18,U(1)-1;A$(1)
4650 PRINT TAB U(1)-1;A$(2)
4660 GOSUB 6950
4670 PRINT AT 18,U(1)-1;U$
4680 PRINT TAB U(1)-1;A$(1)
4685 GOSUB 6950
4690 GOSUB 7020
4695 PRINT AT 19,U(1)-1;U$
4700 LET SB=INT (RND*5+1)*200
4705 PRINT AT 19,U(1);SB
4710 LET SC=SC+SB
4715 GOSUB 1020
4720 GOSUB 7500
4730 PRINT AT 19,U(1);"    "
4740 LET U(1)=0
4745 LET F=0
4750 GOTO 3590
5000 FOR N=-1 TO 4
5010 IF Y=U(3)+N THEN GOTO 5100
5020 NEXT N
5030 GOTO 3560
5100 LET U$="        "
5101 PRINT AT 16,U(3)-1;U$
5102 GOSUB 7020
5110 PRINT AT 17,U(3)-1;C$(1)
5115 PRINT TAB U(3)-1;C$(2)
5120 PRINT TAB U(3)-1;C$(3)
5130 GOSUB 6950
5140 PRINT AT 17,U(3)-1;U$
5150 PRINT TAB U(3)-1;C$(1)
5155 PRINT TAB U(3)-1;C$(2)
5157 GOSUB 6950
5160 GOSUB 7020
5165 PRINT AT 18,U(3)-1;U$
5170 PRINT TAB U(3)-1;C$(1)
5175 GOSUB 6950
5180 LET SB=INT (RND*3+1)*100
5185 PRINT AT 19,U(3)-1,U$
5190 PRINT AT 19,U(3),SB
5200 LET SC=SC+SB
5220 GOSUB 1020
5225 GOSUB 7500
5230 PRINT AT 19,U(3),"    "
5235 LET F=0
5240 LET U(3)=0
5250 GOTO 3590
6950 FOR N=1 TO 5
6960 NEXT N
7000 PRINT AT YU,0,E$
7010 RETURN
7020 PRINT AT YU,0,F$
7030 RETURN
7500 FOR N=1 TO 15
7510 GOSUB 7000
7520 GOSUB 7020
7530 NEXT N
7540 RETURN
8000 PRINT TAB 10;"AIR RAID"
8010 PRINT TAB 10;"▀▀▀▀▀▀▀▀"
8020 PRINT "SCORE ADVANCE TABLE:
"
8030 PRINT
8032 PRINT B$;TAB 10;"50,100,150
 OR 200"
8034 PRINT TAB 8;"-- ENEMY AIRCR
AFT --"
8036 PRINT
8040 FOR N=1 TO 4
8050 PRINT C$(N)
8060 NEXT N
8070 PRINT AT 8,10;"100,200 OR 3
00"
8080 PRINT AT 9,9;"-- BATTLESHIP
--"
8085 PRINT AT 12,0;
8090 FOR N=1 TO 3
8100 PRINT A$(N)
8110 NEXT N
8120 PRINT AT 13,10;"200,400 OR
600"
8125 PRINT AT 14,7;"-- TROOPS CA
RRIER --"
8130 PRINT AT 17,6;"PRESS ""S""
TO START"
8140 IF INKEY$<>"S" THEN GOTO 81
40
8150 CLS
8160 RETURN
9000 PRINT AT 5,0;"OUT OF AMMUNI
TION"
9005 FOR L=1 TO 50
9010 NEXT L
9015 FOR L=1 TO 20
9020 SCROLL
9025 NEXT L
9030 PRINT AT 3,0;"YOUR SCORE WA
S ";SC
9040 LET YU=0
9050 FOR N=1 TO 6
9060 IF SC>V(N) THEN GOTO 9300
9070 NEXT N
9080 PRINT AT 5,0;"TODAY""S SIX-
OF-THE-BEST:"
9090 FOR N=1 TO 6
9100 PRINT AT N+6,5;N;".  ";V(N)
9110 NEXT N
9120 PRINT AT 14,0;"PRESS ""0""
TO PLAY AIR RAID"
9130 GOSUB 7000
9140 GOSUB 7020
9150 IF INKEY$<>"0" THEN GOTO 91
30
9160 FAST
9170 CLS
9180 GOTO 40
9300 FOR L=6 TO N+1 STEP -1
9310 LET V(L)=V(L-1)
9320 NEXT L
9330 LET V(N)=SC
9340 PRINT AT N+6,13;"< WELL DON
E >"
9350 GOTO 9080
```

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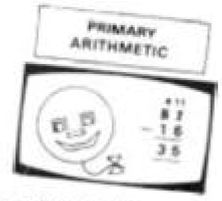
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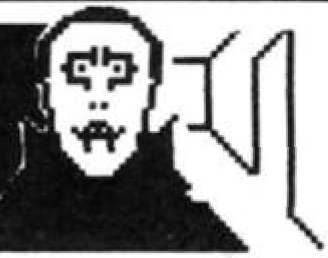
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Sinclair software for your '81

Our intrepid reviewer, Nick Pearce, inspects the new range of software from the Sinclair stable.



Planet Of Death, Ship Of Doom, and Adventure Island — Artic Computing Ltd

Firstly for this month's ZX81 software review, some adventures from Artic. Three of Artic's adventures have been given attractive boxes and more interesting titles (they were known formerly as Adventures A, C and D) for marketing by Sinclair as part of their fast expanding software range.

For the benefit of readers new to computer adventures, a brief explanation of this type of role playing game will not go amiss. An adventure is a game in which you explore strange new worlds with your computer in the comfort of your own home. As the introduction to the Artic games puts it, during an adventure 'the computer acts as your puppet and controls your senses'. Plenty of imagination, patience, and some lateral thinking are necessary if you are to succeed. An adventure is a game with an object — to enter a castle, rescue a princess from the clutches of an evil wizard, and escape with her to safety, for example.

You move from one location to another and there are objects along the way, some of which should be collected as you will need them later on. Hazards of one sort or another abound, and you will need to overcome them all. Each location is described by the computer, and you instruct it with short phrases such as 'Go East', 'Get knife', 'Use torch', etc. The computer then provides an appropriate response such as a new location description, 'I can't' or quite often 'I don't understand'. It is a good idea to make a map as you proceed to stand any chance at all of retracing your steps to safety.

All the Artic adventures are written in machine code and are very fast; response to commands is practically instantaneous. They each have an impressively large vocabulary of over 100 words. The programs are long, and take 5½ minutes (Adventure A) to 7 minutes (Adventure D) to LOAD.

Forbibben Planet

Planet of Death (Adventure A) has about 20 locations and a similar number of objects. You are stranded on an alien planet, and the object is to escape by finding your space ship which has been captured and disabled.

You really are in a strange world of the imagination. There are caves, a prison, a lift (but the buttons are rather high, and where does it go?), guards and green men, and much more besides. There is also a maze, a feature common to many adventures and which, as usual, I found very quickly. Once that happens in an adventure I quit and start again, making sure from then on that I stay well clear of the maze at all times!

In Ship of Doom (Adventure C), your ship, whilst on a reconnaissance flight, has been drawn by a Graviton Beam onto an alien cruiser. Your aim is to free your ship by pressing the control button in the main computer room. You commence in your ship, and begin by moving into the airlock of the alien cruiser. This is a long adventure with some 40 locations — a radio room, robot factory, weaponry, cold room, galactic bar, an android conversion room to name a few.

There are also about 40 objects including a sonic screwdriver, infra-red spectacles, even a body frozen in ice and a beautiful android girl. I won't go into too much detail over what can be done with her, suffice to say that she is programmed for satisfaction — some parts of this adventure are definitely for adults only.

There is the odd spelling slip in my copy of the program, (exits becomes exitw in the log room, for example), but nothing is seriously wrong. In some places the program is surprisingly flexible, it accepts both the instructions 'turn' and 'rotate', for example, although some other commands have to be infuriatingly precise. In all the Artic adventures you can speed up data entry, by typing 'N' for North and 'Y' for yes, for example.

All the Artic adventures are extremely absorbing. They can also be very frustrating; it is possible to spend a whole evening stuck in one small area of the game unable to solve a problem that will allow you to move further. However, some time later and after giving up all hope of completing the game, the answer will hit you in a flash of inspiration and you can move on

```
I AM ON A MOUNTAIN PLATEAU
TO THE NORTH THERE IS A CLIFF
EXITS ARE DOWN,EAST AND WEST
I CAN ALSO SEE :
A PIECE OF SHARP FLINT
TELL ME WHAT TO DO
PICK UP FLINT

I CANT
TELL ME WHAT TO DO
GET FLINT

 OK...
TELL ME WHAT TO DO
GO NORTH
I CANT GO IN THAT DIRECTION
TELL ME WHAT TO DO
```

A sample screen dump from Planet of Death.

— until you reach another seemingly intractable problem a few locations later. An adventure can take days to complete!

Both Adventures C and D are very long and incorporate a cassette routine with which a partly completed game can be SAVEd, and LOADed at a later date — a very necessary feature.

I spy...

So absorbing were the previous two adventures that the deadline for this issue dawned before I had managed to complete Artic's final adventure — Espionage Island (D), so I am afraid much of it remains uncharted for the present. On the basis of the part I have so far explored, I am confident that it will prove an excellent game.

Perhaps in another edition of this magazine I will be able to give away a few of its secrets. For the present, the plot is as follows.

The intrepid adventurer is sent on a reconnaissance mission to observe an enemy island; there is a secret hidden somewhere on this island which must be discovered. Unfortunately, your plane has to be abandoned when one of its engines is hit by enemy fire. The adventure begins in the aeroplane and leads into the heart of the enemy stronghold, from which you must eventually return to safety. This is a very difficult game, only to be attempted by the experienced adventurer. Even getting out of the aeroplane and safely onto the island is a problem — or at least I found it so — and I haven't yet managed to get much further forward.

```
I AM IN AN AIRCRAFT
THERE NO OBVIOUS EXITS
IN ALSO SEE :
A PARACHUTE WITH A CORD
A DOOR LEVER
TELL ME WHAT TO DO
GET PARACHUTE
OK..
TELL ME WHAT TO DO
OPEN DOOR
THE DOOR OPENS, PULLING YOU OUT
WITH A RUSH OF AIR
YOU PLUNGE THROUGH THE AIR
AND MAKE A LARGE RED MESS
YOU ARE DEAD*
DO YOU WISH TO TRY AGAIN?
ANSWER YES OR NO
```

A sample screen dump from Espionage Island.

All the Artic adventures seem to be from the same original master program, but I don't think that once you've mastered one, the others will be a doddle. Each is original in content, and challenging. Planet of Death is the shortest, with the fewest locations and objects but will nevertheless provide many hours of enjoyment. The quality of software for the ZX81 is constantly improving, and at the same time prices are, if anything, falling. Some readers might feel these Artic cassettes are still a little expensive; however, there can be little doubt that they are very good adventures indeed.

Artic Adventures A, C and D cost £5, £7 and £8 respectively, and are available from Artic Computing Ltd, 396 James Reckitt Avenue, Hull, HU8 0JA, or through Sinclair Research Ltd (see below).

Reversi — Mine of Information



Reversi is a late nineteenth century board game. Mine of Information's computer version also goes under the name 'Othello' (as readers of the letter pages of this magazine will no doubt recall).

It is a game of skill between two players using a draught board. Counters, black on one side and white on the other, are used. A move is made by placing a counter on a vacant square next to an opponent's counter, and each move must result in the 'capture' of an opponent's piece — a capture is made by trapping a counter showing the opponent's colour (or a line of such counters) between the new counter and one showing your own colour already on the board. The game ends when neither player can make a capture. The winner is the player with the largest number of counters showing their colour.

Now to MOI's game. After LOADing the cassette, a menu is displayed and you can choose to play a game against an opponent, a game against the computer, a 'sample' game, or to change the start position. Using this latter facility you can select for yourself a few advantageous positions — the corners, for example — to give yourself a chance against the computer! For the novice, the sample game is very useful for gaining familiarity with the rules and learning something of the strategy behind the game. You can go forwards and backwards through the sample game so that the effect of each move can be clearly seen.

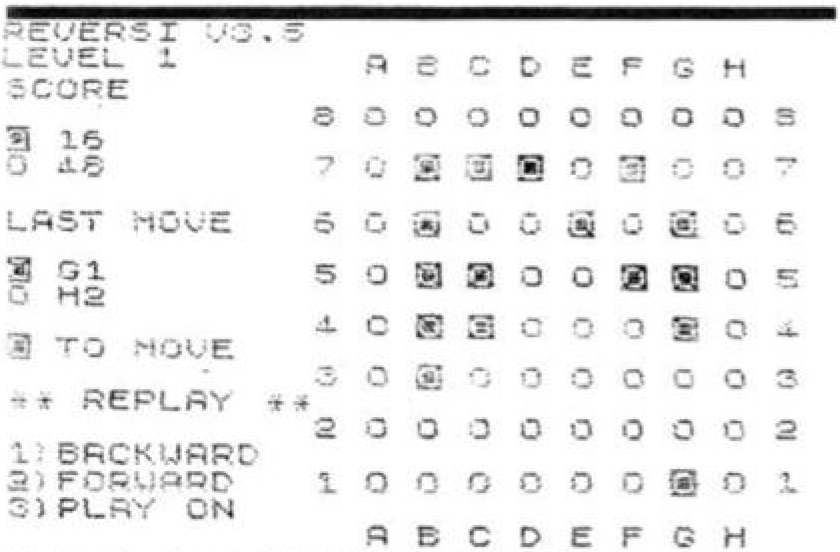
The board is displayed on the screen with the square co-ordinates (A to H on the horizontal axis, 1 to 8 on the vertical scale), displayed along the board edges. White and black pieces are denoted by 'O' and 'inverse O' respectively. The display includes the current score and the co-ordinates of the last move. After each move, the computer 'flashes' the pieces captured for a few seconds — a nice touch.

No Cheating!

The computer checks that the chosen moves are valid. Each time it is your turn to move, you can call up various game options — change level of play, replay last move, change sides, pass, or return to BASIC. There are nine levels of play, the response at levels 1 and 2 is practically instantaneous; levels 4, 5 and 6 take about three, 10 and 40 seconds respectively, up to level 9 which takes a very long time indeed. Harder levels of play take longer as the computer looks further ahead and so has more possibilities to evaluate. I was somewhat disconcerted when I first tried level 9, the screen goes blank and after waiting for a while nothing happened and I thought the program had crashed. It would be nice if the board was displayed, perhaps with some reassuring message such as 'wait please, I am thinking', whilst the computer evaluates its next move. At least you can then ponder your following move.

The hardest levels really take far too long between moves for a sensible game to be played. In any case, levels 1, 2 and 3 are hard enough for even a good player. If you can beat it at level 4 you must have played this game before, to beat it at level 5 you must be very good indeed!

The cassette is recorded on both sides, and the game takes about three minutes to load. It is written almost entirely in machine code. Well-written instructions, complete with some hints on tactics and strategy, are included in the package. Reversi is a very sophisticated program, easy to use and enjoyable to play. It is probably the best 'Othello' program for the ZX81 on the market, and will certainly improve the play of both beginners and more experienced players alike. ▶

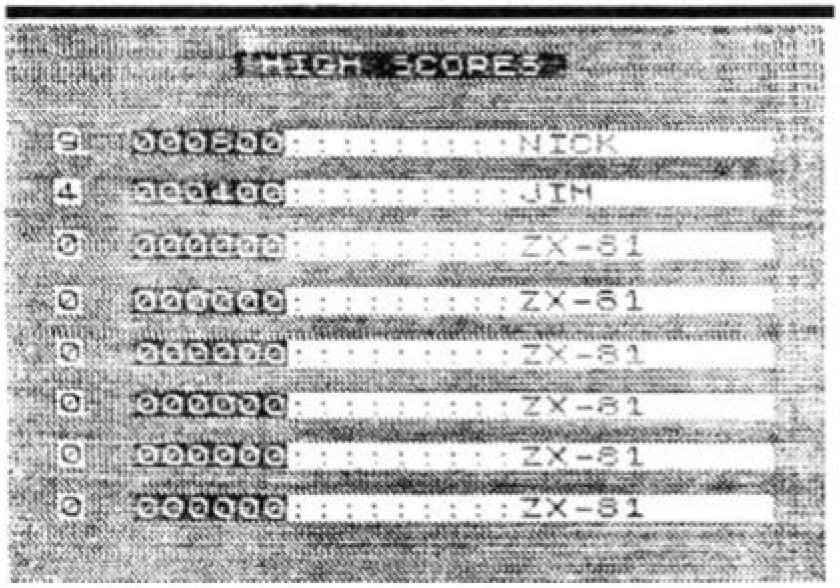


The board and score table of the game, Reversi.

Super Glooper — Psion

I am sure readers will not need reminding that six Psion software cassettes were reviewed in the Oct/Nov 1982 issue of this magazine. Super Glooper is a cassette from the same stable, and like the other Psion software is also marketed by Sinclair.

The cassette contains two games and on the A side is the title game, Super Glooper. It is, I suppose, really a 'Pac-Man' type game in reverse. Instead of rushing around a maze eating food pills or whatever, in this one you 'paint' each square of the maze as you go over it.



The score board for the Frogs game.

There are, of course, four aliens who roam the maze, and the object is to paint the whole maze before they catch and destroy you. You have four lives per game. In each of the four corners of the maze is a shield, and if you can reach one of these you may catch one, or more, of the aliens.

For each square in the maze that is painted, a score of 10 points is given, and for each shield you get 50 points. It is profitable to chase the aliens — once you have a shield, of course — since you get an incredible 1,600 points if you catch all four aliens with one shield. Of course, shields do not last for long, and catching more than even one alien is not an easy task.

Hang on...

A nice feature of this game is a pause facility. If you get in a fluster — with an alien close by, you might suddenly be unable to find the right keys to get away from him — you can pause, or freeze, the game while you compose yourself. However, I found Psion's choice of control keys rather difficult to get used to. Keys 1 to 5 move you up, for example, whereas I would rather be able to use *any* of the keys in the top row for up. This is, of course, very much a matter of personal preference, other players might well by quite content with Psion's layout.

If you manage to completely paint a maze, more difficult mazes appear. If you find the slowest speed to easy, there are five levels of play to choose from and these can be selected at the start of each game.

Super Glooper is written in machine code. It is a short program and takes only 80 seconds to load. If you have already got one of the many versions of Pac-Man now on the market for your ZX81, you will probably not be very interested in this game. If not, you may well find it a useful addition to your library of games. Not a particularly inspired game, but competent and well-written, and quite good fun.

Jump to it

I also found Frogs, on the B side, an enjoyable game. It is similar to 'Frogger', the basic idea being simple but quite effective.

The screen displays a river with two banks, one at the top of the screen and the other at the bottom. On the river are nine lanes of boats, with boats in adjacent lanes travelling in opposite directions, left to right and right to left across the screen. (The screen looks rather like a bird's eye view down on a *very* busy motorway).

Eight frogs wait on the lower bank and the object is to help them each in turn across the river to five jetties on the upper bank. They must jump from boat to boat, if any land in the river or miss a jetty they are lost. Points are scored for each frog that successfully crosses the river. Two factors make this game more difficult: there is a time limit for each game (100 seconds); and once a jetty has been reached by a frog, that jetty cannot be used again in that game. Whilst the jetties 'downstream' of the last lane of boats are relatively easy to reach, those farthest upstream are much more difficult to land on.

As well as jumping forwards across the river, frogs can jump backwards and left and right along the top of the boats (although they cannot jump from the back of one boat to the front of another coming along behind). Apart from the last frogs, where some manoeuvering is sometimes necessary to get to a still vacant jetty, I found I tended to use the forward keys only.

Again, this is a machine code game and the program is quite short taking about 1½ minutes to load. Movement is smooth and the game is pretty well idiot proof. There are nine levels of play, harder games having faster moving boats. A league table that can record the scores of up to eight players is displayed at the end of each game, so a competition between players can be held.

This is the sort of game that requires a lot of concentration. It would probably make a very good alternative to the breathaliser test — a drink or two and I would imagine that it would become well nigh impossible to get any frogs across as the moving boats just form a blurr in front of your eyes.

Frogs is not a complicated game, but it is well-written, works well and is enjoyable. At £4.95 for the two games, this cassette represents reasonable value for money.

Reversi costs £7.95 and Super Glooper costs £4.95. All the cassettes featured in this review are marketed by Sinclair Research and are available from: Sinclair Research Ltd, Stanhope Road, Camberley, Surrey and selected branches of WH Smith Ltd.



Adding on your Spectrum

Our review team take a brief look at some of the hardware add-ons for the ZX Spectrum.

Now that the ZX Spectrum has well and truly established itself on the micro market, it is amply supported by a wealth of hardware add-ons. Most of these peripheral devices have been manufactured by the people who supported the ZX81, but just as the Spectrum has attracted new users with its prowess, so too has it attracted a new following from the add-on manufacturers.

In this brief guide, we have not tried to cover all the devices currently available on the market but rather give you a flavour of the technology you can add on to your Spectrum. As joysticks are an obvious favourite, these have been covered in some detail whereas RAM packs are fairly standard and so have only been briefly touched on. Also included in this section are a number of quite specialised add-ons like sound units and a digital tracer.

If you own a Spectrum, you will no doubt have begun to realise the potential you hold in your hands. Over the next few pages you will hopefully see further applications for you and your computer to explore.

Joystick interface module — AGF Hardware

The AGF joystick interface, a version of which is also available for the ZX81, has been designed to connect to the back of the Spectrum via the rear edge connector. There is also an extension edge connector allowing further devices to be added. The interface is built solidly but is not completely closed off. The connection to the read edge connector is good, and can be easily removed without too much worry of it falling apart in your hands.

The special feature of the AGF interface is that it includes an enable switch which makes the keys of the Spectrum inoperative excepting the 2, W, S, Z, 9, 0, L and Symbol Shift keys. There is room for two joysticks, and the positions for the joysticks are both clearly marked.

Moving onto the joysticks themselves, they are very reminiscent of those employed by the Atari computer. As can be seen in the photograph, they are very solid with an easy-to-grip stick made of hard rubber-like substance. The joysticks at first seemed a little stiff, but with use could be manipulated with precision. The red firing button was easy to use when moving the stick and always fired when you wanted it to.

The joystick interface and joysticks come complete with instructions and a short piece on using the joysticks in your own programs. The hardware is also covered by a three month guarantee for the joystick and 12 months cover for the interface.

The first commercial program written for two players using the AGF joystick arrangement is soon to be available from Silversoft. AGF are also selecting other programs for use with their joysticks.

The cost of one joystick and interface module is £23.50 and comes complete with a free demonstration program, Video Graffiti. Extra joysticks are priced at £7.45 each. For further details of these devices contact AGF Hardware, 26 Van Gogh Place, Bognor Regis, West Sussex PO22 9BY.

Joysticks



The joystick interface module from AGF Hardware, complete with Atari-style joysticks.

The Spectrum Add-on — Micro Power

The Micro Power Add-on is a board which fits onto the edge connector at the rear of the ZX Spectrum. This connection is good and solid, but when you want to remove it you get the feeling that you are going to pull off some of the components as well! (However, it must be said that the Add-on board remained intact throughout the review.)

The Add-on board is claimed to give users three advantages. Looking at them in order, the first is that it provides three channel sound effects via the popular AY-3-8910 chip from General Instruments. This sound generator allows you to control sound, accessing various sound effects by the use of BASIC within the program. By this method, you can easily introduce simple effects such as a gun-shot within a program — the presence of the speaker on the board makes this quite effective.

Utilising the 2W amplifier and loudspeaker built into the Add-on is easily done by plugging the attached jack plug into the earphone socket of the Add-on to amplify the output of the sound chip. You can also plug the jack plug into the MIC socket at the back of the Spectrum to amplify the output of the computer's BEEP commands.

Provision is made for two joysticks to be fitted to the Add-on and are available from Micro Power as kits. The joysticks, once constructed, are easy to hold and the stick is easy to manipulate. Connection to the Add-on is via a quite flimsy connection, but this seemed to hold up reasonably well during the review period.

The cost of the Add-on board is £19.50 + VAT and comes complete with full instructions for use. The joystick kits are priced at £3.95 + VAT. For further details of these products get in touch with Micro Power, 8/8A Regent Street, Chapel Allerton, Leeds LS7 4PE.

Joystick board — Intercepter Micro's

This interface board is designed to connect a standard Atari-type joystick to the ZX Spectrum.

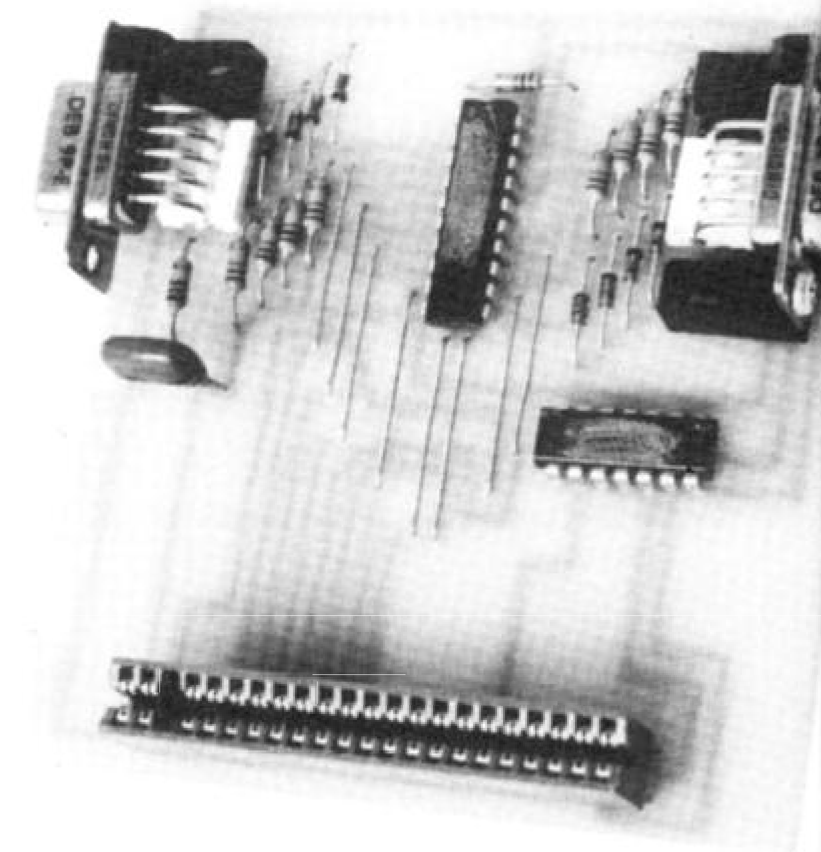
The board itself is not boxed and felt very fragile when plugged into the back of the Spectrum. There is also room at the rear of the board to interface further add-ons should you so desire. Two positions are available for you to insert joysticks, and although the connection did not seem at all strong, the joysticks worked adequately.

Instructions are provided for the user to check that the interface board is working up to the standards required, and a demonstration cassette is included in the package for demonstration of the joystick, once connected. The supplied software demonstrates various programming methods including machine code and control over sound and screen movement.

Interceptor Micro's offer any users their help with converting any software that you may already own so that it will operate with the joystick board, and are currently offering to market any software produced written using the board.

The cost of the joystick is £15.95. For further details of this product write to Interceptor Micro's, Lindon House, The Green, Tadley, Hants.

The joystick board from Interceptor Micro's offering facilities for two Atari-style joysticks.



Competition pro-joystick — Kempston Micro Electronics

The Kempston joystick is a very solid looking device. Housed in black plastic, the joystick has a thick stick with a bulbous handle which makes it very easy to grip. There are two firing buttons, each brightly coloured red, sup-



The Spectrum Add-on from Micro Power — connected in the photograph to amplify the computer's BEEP commands.



The solid-looking Competition pro-joystick from Kempston Micro Electronics.

posedly for left or right handed players (Heaven forbid that software games become so complex that you have to choose between the type of laser you blast the aliens with!).

The joystick comes complete with a boxed interface which easily plugs in and out of the rear edge connector of the Spectrum. It does not, however, have any facility for any other add-on to be fitted once the joystick is in position.

The joystick operation is easily programmed for in BASIC or machine code, and full instructions plus a number of demonstration programs are provided for you to get the hang of it. At the time of writing, the Kempston joystick was compatible with at least five games on the market, including those from Quicksilva, Softek, Abbex and New Generation.

Operation of the joystick was a bit stiff at first, but once you get used to it, skillful manipulation was possible.

The cost of the Kempston joystick is £25. Further details on this device are available from Kempston Micro Electronics, 180A Bedford Road, Kempston, Bedford MK42 8BL.

Analogue input device — Midwich

This interface is once again not boxed. Good connections are made when the board is plugged into the Spectrum, but there were fears (unfounded as it happens) when it had to be removed. The Midwich interface lies horizontal out of the back of the Spectrum, rather than vertical like the rest of the review samples, and there were the nagging fears of the 'RAM pack wobble syndrome' happening all over again.

The interface board is available from Midwich as a kit, and as such comes complete with full instructions for assembly. Once you have completed its manufacture, there are also a number of programming suggestions which can be utilised to test the unit. Provision is made for two joysticks, and although the DIN plugs are used for a good connection, the board did not feel very safe whilst the connections were made. Removing the joysticks from the board involved some fairly vigourous manoeuvering as well, which did not feel very confident.

The joysticks supplied with the sample were fairly sturdy and held up well in operation. The feel of them was a little floppy, but they nevertheless worked adequately. The firing button, emphasised in bright red, operated whenever it was needed without any worries.

The cost of the analogue input interface is £22.95 and each joystick is priced at £7.99. For further details of Midwich products contact Midwich Computer Company Ltd, Rickinghall House, Rickinghall, Suffolk IP22 1HH.



The Analogue input device complete with joystick from Midwich Computer Company.

Sound and vision

The Chatterbox speech synthesis unit from William Stuart Systems.



Big Ears — William Stuart Systems

Originally designed for the UK101 and Superboard, the Big Ears speech recognition system is now available for most leading micros including the ZX Spectrum.

Housed in a sturdy box, the Big Ears system consists of a microphone, pre-amplifier, analogue frequency filters and digital interface. You are also supplied with a software package allowing you to become acquainted with what you soon find is a very complex piece of technology. The program with the system has four modes, Learn, Test, Demo or Save. All the modes are fairly self-explanatory, and the demo explains all should you require comprehensive details.

Using the equipment, you can allow the Spectrum to learn a word, you can then test that the computer understands and recognizes that word, and then save the program together with its new expanded vocabulary.

During the review period, we had the Big Ears programmed to recognise nearly everyone's name in the office. And this it did quite successfully, except for the name 'Helen' which it seemed to 'recognize' every time it wasn't quite sure!

Complete with full instructions for use, the Big Ears speech recognition system is priced at £49. For further details of this device, contact William Stuart Systems Ltd, 44 Bedford Gardens, London W8 7EH.

Chatterbox — William Stuart Systems

Chatterbox uses a novel method of forming speech – it does not contain a fixed vocabulary, but rather depends on the building up of individual sounds (or phonemes) under program control.

The Chatterbox itself is a nice solid box with a speaker unit built into the front. The output from the speaker is clear and set at a reasonable volume. There is also a speaker output at the back of the unit, as well as an audio output which could be played through your hi-fi. The Chatterbox is connected to the rear edge connector of the Spectrum and provides room for additional hardware to be added on.

The speech output from the unit is of quite high standard and is certainly fun to play with. By POKEing various codes, it is possible to build up words by their basic sounds. It sounds fairly easy, but it can take quite some time to find exactly the right sounds you need before anyone can recognise what you are trying to say. It is a triumphant moment though, when your Chatterbox finally puts together its first word.

The unit comes complete with a list of codes with which to experiment with and use as building blocks, as well as some program examples of how to utilise the device within your programs.

The Chatterbox is priced at £49 or £39 as a DIY kit. For further details contact William Stuart Systems Ltd, 44 Bedford Gardens, London W8 7EH.

ZONX — Bi-Pak Semiconductors

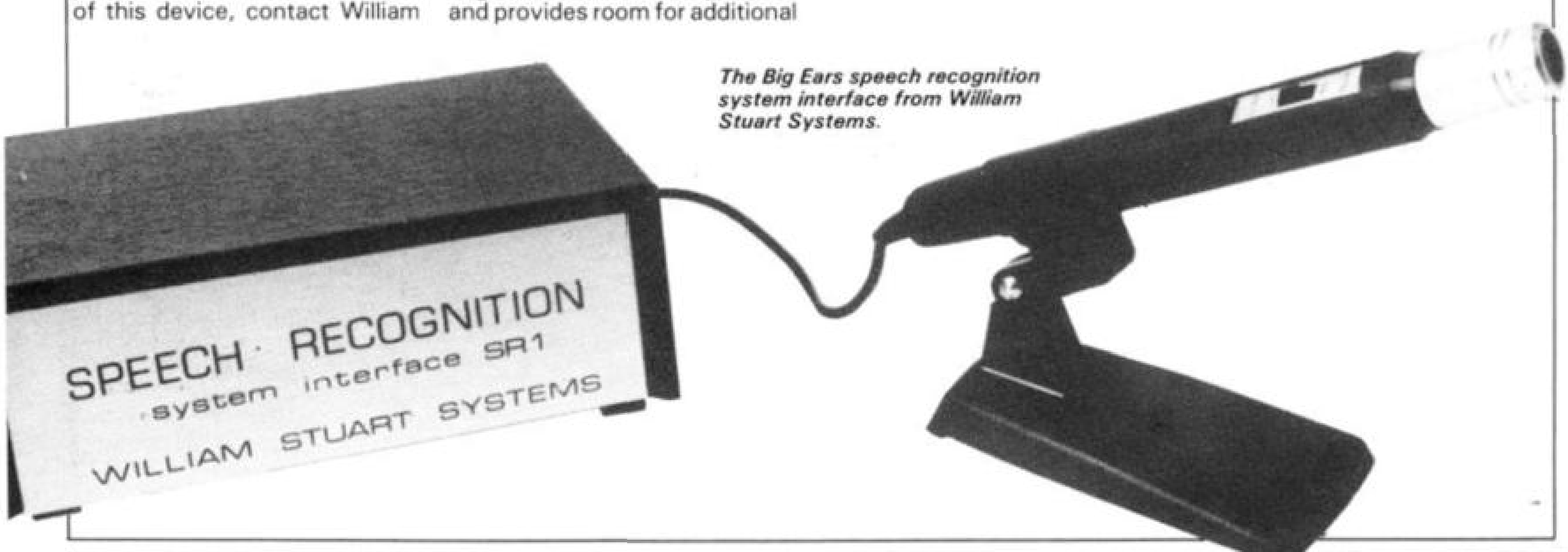
Originally designed for the ZX81, Bi-Pak have now released an adaptor so that the ZONX-81 can now be utilised with the Spectrum.

Self-contained in a strong plastic box, the unit easily plugs into the rear of the Spectrum forming a good connection. There is a manual control for the volume, the sound produced being clear and within a reasonable volume range.

Using the unit, via simple BASIC commands included within a piece of software, a wide range of sound effects can be produced by the three channel plus noise chip housed within the unit. Thus, depending on various statements within a program, the pitches and volumes of three channels and overall attack/decay envelope can be manipulated. And what that means is that you can get quite realistic sound of explosions, helicopters, bells, etc.

There is an interface at the rear of the device which means that you could add other devices on the back of the Spectrum at the same time as your ZONX.

The Big Ears speech recognition system interface from William Stuart Systems.



Complete with a very comprehensive manual with tried and tested software examples, the ZONX is priced at £32.75. For more information contact Bi-Pak Semiconductors, The Maltings, 63A High Street, Ware, Herts SG12 9AG.

S-Pack — DCP Microdevelopments

This is another product which first cut its teeth on the ZX81. Plugging this unit into the back of the Spectrum, you can make the S-Pack work wonders in seconds. With a few simple key presses, it announces 'This is Digitalker' (which is what it used to be called!).

The unit comes supplied with a total vocabulary of 71 phrases, numbers or letters. They at first sight do not seem very inspiring, but at closer inspection, they all seem to be fairly useful. Should you get bored with these sounds, DCP have three other Word Packs which are supplied as ROMs and just need to be allowed for in your programming for inclusion in a new program. These Word Packs are priced at £14.95 each, so check out that you are interested in the complete vocabulary before looking too closely at the unit.

The S-Pack is housed in a black box with a good edge connector and an expansion connector should you wish to hang anything else on the back.

The S-Pack, complete with Word Pack 1, is priced at £49.95. Further details are available from DCP Microdevelopments Ltd, 2 Station Close, Lingwood, Norwich NR13 4AX.



The ZONX-81 speech pack complete with interface for use on the ZX Spectrum from Bi-Pak Semiconductors.



The S-Pack from DCP Microdevelopments.



The Digital Tracer unit from RD Laboratories.

Graphics

Digital tracer — RD Laboratories

The device from RD Laboratories must be singled out as special if only for its cheap price — this sort of technology has normally only been available for up-market computers.

The Digital Tracer comes complete with an instruction booklet, a tracing sheet and a template which is used for alignment. The cassette supplied with the package includes four programs which can be used individually or MERGEd and used together. Using the programs you can plot individual points, draw lines, alter the background and foreground colours, shading areas enclosed by the tracer, printing and editing of text on screen. Thus, you could, using the Digital Tracer, transfer a picture or diagram to the screen, further develop it using the editing facilities, and then SAVE the screen to tape.

In practice, however, the digital tracer is a little tricky to use. As you draw using the tracer, a crosshair target comes up on the screen, and by skillful manipulation, very accurate drawing can be accomplished. However, when you start trying to fill in areas of the screen, or adding fine detail to your drawing, it does get a bit awkward. Since the software is written in BASIC, rather than machine code, it would seem fair to lay the blame for any of the tracer's shortcomings at the software's door.

Other programs on the cassette include a co-ordinates program which can be used to move an origin and x and y co-ordinates around the screen. Another program allows you to draw at a fast speed with the tracer, with the computer plotting the points at a slower rate. And the last program is used to define user characters, but is not intended for use with the tracer.

All in all, a useful device which faithfully reproduces the drawing action on screen. The Digital Tracer is available at £49.95. For more details on this product contact RD Laboratories, Unit 20, Court Road Industrial Estate, Cum Barn, Gwent NP44 3AS.

Extra, extra

32K RAM — JRS Software

The 32K RAM option for the 16K Spectrum is offered in two forms, one for each issue of the ZX Spectrum.

The first issue can be upgraded to 48K using a RAM board which is fitted inside the Spectrum. Installation is easily done and requires no soldering, just some very careful fitting. The retaining screws in the base of the Spectrum are undone and, by carefully lifting up the cover, the board can be placed over and firmly pushed into the place indicated in the instructions that come with the RAM board. Once in place, the Spectrum is closed up and operates as a 48K machine.

Perhaps a better way of upgrading can be done as in the method employed in the second issue of the Spectrum. Here you are supplied with 12 ICs, all clearly marked with a letter, A, B, C, D or E. Using the diagram supplied, you carefully undo your Spectrum and position the ICs as shown in the accompanying documentation. Once fitted, the Spectrum can be put back together again and you have a 48K machine.

Both methods of upgrading were easy to accomplish and both proved effective during the period they were tested for review.

The 32K RAM board for the first issue ZX Spectrum is priced at £42.50 and the 32K ICs for the second issue Spectrum cost £42.50. For further details contact JRS Software, 19 Wayside Avenue, Worthing BN13 3JU.

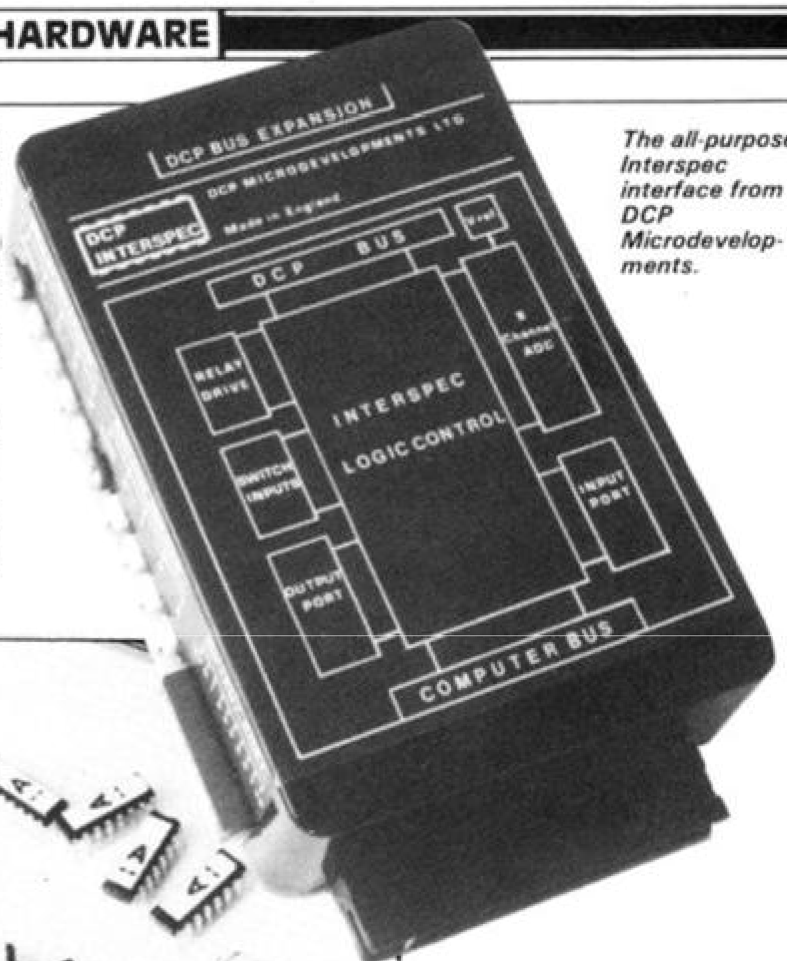
Interspec — DCP Microdevelopments

This one unit provides virtually the complete interface package that anyone would want on their computer.

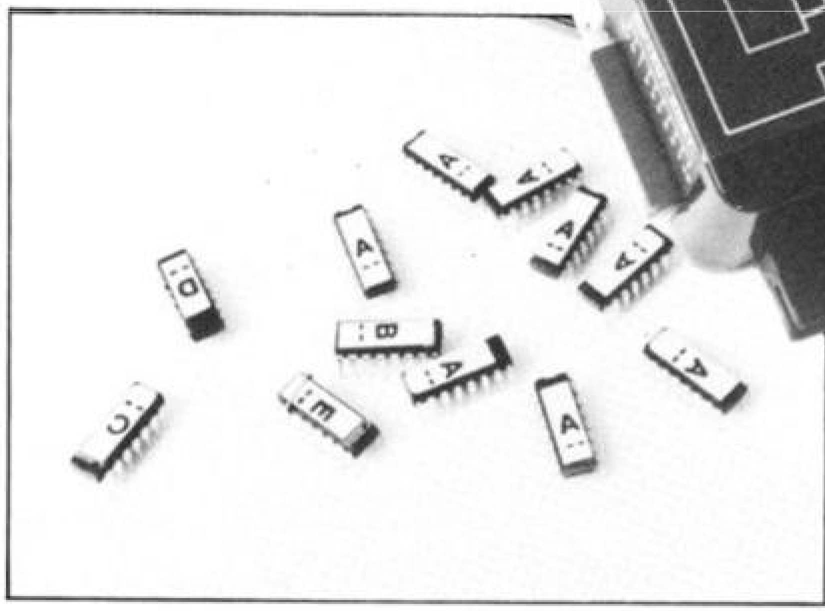
For the dedicated programmer, you'll find an eight-bit TTL input port, an eight-bit TTL output port, an eight channel analogue to digital converter, four high current relay outputs and four switch inputs. Also, fitted to the rear of the Interspec is a BUS connector which has all the necessary data, power and decoded address lines to add more peripherals.

Cased in a smart looking unit, the Interspec package comes complete with detailed instructions on how to get the most out of the unit, backed with hardware and software examples.

Priced at £39.95, you can find out more about the Interspec unit and its control applications from DCP Microdevelopments Ltd, 2 Station Close, Lingwood, Norwich NR13 4AX.

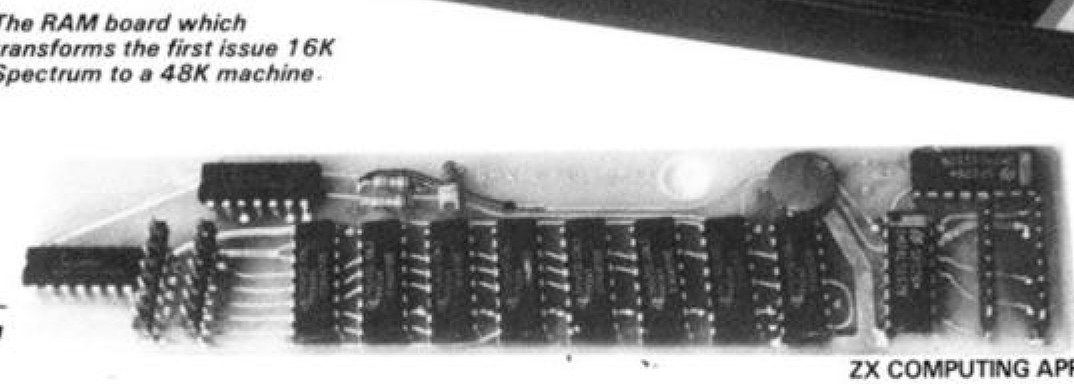


The all-purpose Interspec interface from DCP Microdevelopments.



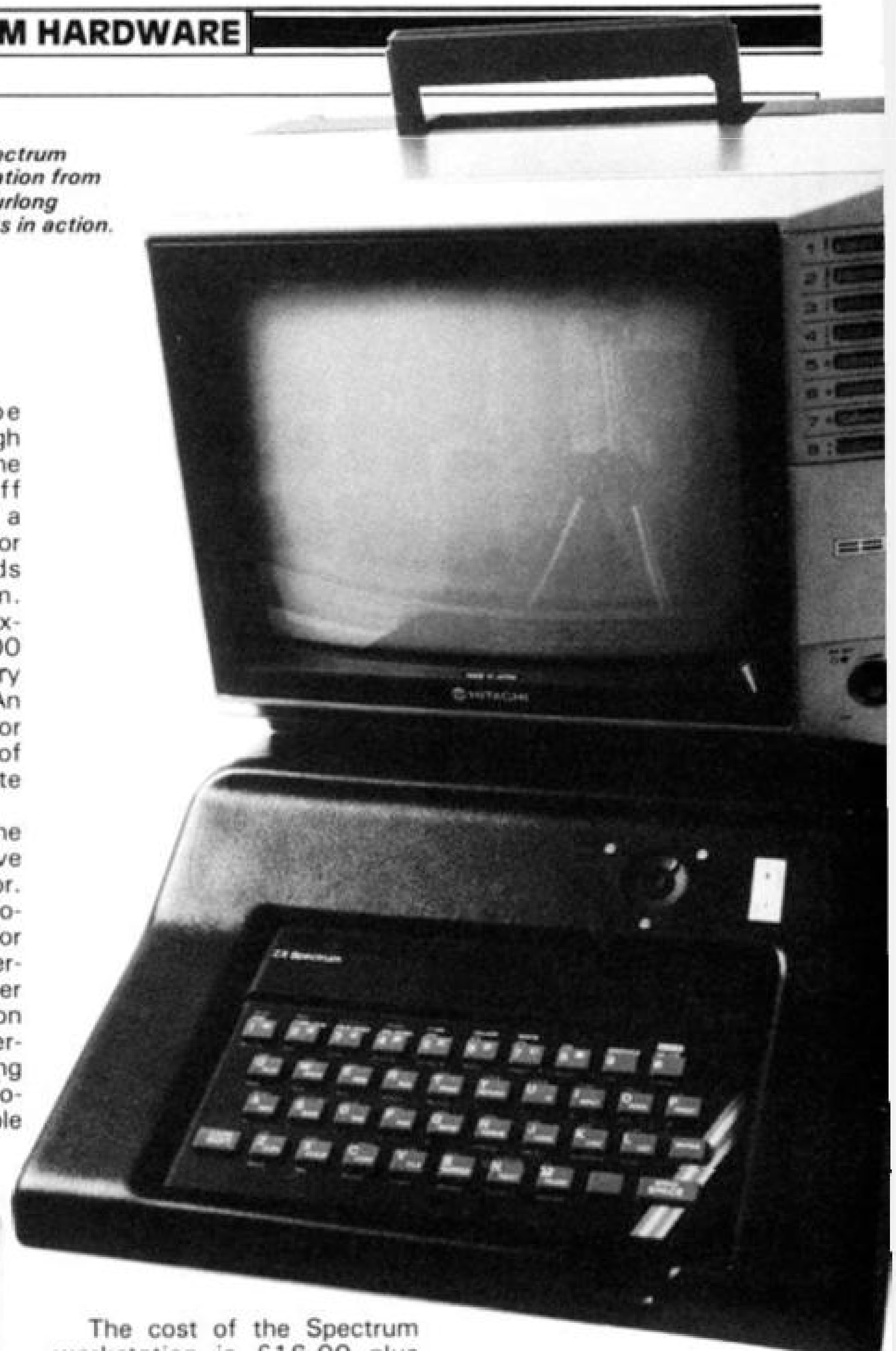
The 12 ICs which make the second issue 16K Spectrum up to a 48K device from JRS Software.





The RAM board which transforms the first issue 16K Spectrum to a 48K machine.

Settling down?



The Spectrum workstation from Peter Furlong Products in action.

Spectrum workstation — Peter Furlong Products

If you're going to settle down with your Spectrum and you want security, then this may be what you're looking for — it makes the Spectrum into a very smart looking system.

Constructed from durable ABS plastic, the workstation would certainly stand up to a fair amount of punishment. The Spectrum fits into the slot built into the front of the unit, and the trailing wires (to the TV, PSU, printer, etc) are to be slotted through small holes cut into the plastic frame. This operation is actually more difficult than it may at first seem, especially as you are required to do some quite tricky soldering to attach the speaker connections to the Spectrum. (The speaker is available as an extra for £3.50.)

Two switches can be attached to the unit (although only one switch is shown in the review sample), an on/off switch for the Spectrum and a LOAD/SAVE switch catering for the bizarre switching leads situation on the Spectrum. These are both counted as extras and are priced at £3.00 each, but are extremery necessary for best operation. An alloy base is also available for the unit, at the additional price of £3.50, which comes complete with rubber feet for grip.

The PSU is hidden inside the main body of the unit above which sits the TV or monitor. The plinth is raised slightly providing a good angle of view for the user. (Should the TV overhang the workstation, Peter Furlong Products are working on an extention bracket to overcome this problem). A matching stackable unit for the ZX Microdrives will soon also be available to match this unit.

The cost of the Spectrum workstation is £16.00 plus £2.00 postage. Further information is obtainable from Peter Furlong Products, Unit F, South Coast Road Industrial Estate, Peacehaven, East Sussex BN9 8NA.

Spectrum custom case — Computex Cases

And if you have settled down to just using a Spectrum, how about a case to carry all your computing bits and pieces around town in.

Aimed at the business user with the typical business-person's case, the custom case has been designed to allow for all that you would need to carry around with you, including room for the much heralded ZX Microdrives. Each piece of equipment is held securely in shock absorbant foam, with the individual devices connected up under the foam for good connection.

Should you have the opportunity to power up your Spectrum system, you can simply unhinge the lid of the custom case and begin work. The top of the lid includes a number of wallets for papers and books, with smaller compartments for pens, cassettes, etc. Constructed from ABS plastic, the cases are certainly strongly built and provide a very useful, if luxurious, addition to the family of Spectrum peripherals.

The Spectrum custom case cost £34.95. For further details contact Computex Cases, Stanhope Road, Camberley, Surrey GU15 3PS.



Full to bursting! The Spectrum custom case from Computex Cases.

JOIN THE USERS' CLUB

FREE BOOK!

Make the most of your Spectrum or ZX81 by joining the country's strongest and most enthusiastic users' club—the National ZX Users' Club.

When you join us, we'll send you our 'new members welcome pack' with 30 programs (15 for the ZX81, 15 for the Spectrum), plus the first issue of our value-packed club magazine INTERFACE.

Inside INTERFACE as well as at least six programs for your ZX81 or Spectrum, you'll find letters from members as they share tips and ideas, and sound off on a variety of subjects (such as you-know-who's appalling delivery times record), a list of local ZX clubs, and special offers from software houses and book publishers—special offers just for members.
If you're having problems with your computer, we have experts on tap to try and help you. If you want to start a local users' club, we'll give you publicity, and let you buy books at a special discount for your club members.
If you're not a club member, you're missing out on making the most of your micro (and try saying that ten times quickly!) Come on in and join us, the water's fine. It's £9.50 for a year's INTERFACE, and we'll send you a sample issue for £1.00

Run by Tim Hartnell, the National ZX Users' Club is a resource just waiting to be tapped. Come on and start tapping.

National ZX Users' Club,
Dept. **ZC**
44-46 Earls Court Road,
London, W8 6EJ

OK, Tim, you've convinced me:

( ) Send me my 'new members' welcome pack' plus my first issue of INTERFACE and keep those INTERFACES coming for the next year. I enclose £9.50 (UK), £12.50 (Europe)

( ) Just send me a sample of INTERFACE. I enclose £1.00

I have ( ) a ZX81 ( ) a Spectrum

Name ....

Address ....

....



- Stylish case fits neatly between ZX81 and Ram pack of 8K or more
- 256 x 192 pixels
- Hi res display file independent of old display file
- Very fast and powerful graphics commands as extensions of Sinclair basic. SLOW / FAST CLS COPY PRINT PLOT all extended to hi res
- **114 PLOT modes including:**

  Points and various line types
  Textured triangle fill
  Absolute and relative co-ordinates
  Line drawing to points off screen

- **Mixed text and graphics including PRINT at graphics cursor.**
- **User defined graphics for space invaders etc**
- **Screen COPY to printer**
- Extensive manual, excellent for school and home use, and full guarantee
- Arcade games available soon!

Post to:– Notting Dale Technology Centre (Ltd)
T.F.L. (ZX 81)
189 Freston Road
London W10 6TH (01-969 8942)

*

Please send me .... board(s) @ £32.00 each
+ £4.80 VAT plus 75p P&P

I enclose Cheque/P.O. for ....
Or I wish to pay by Access/barclay Card/Visa

Card Number ....

Name and Address (PRINT)

Name ....

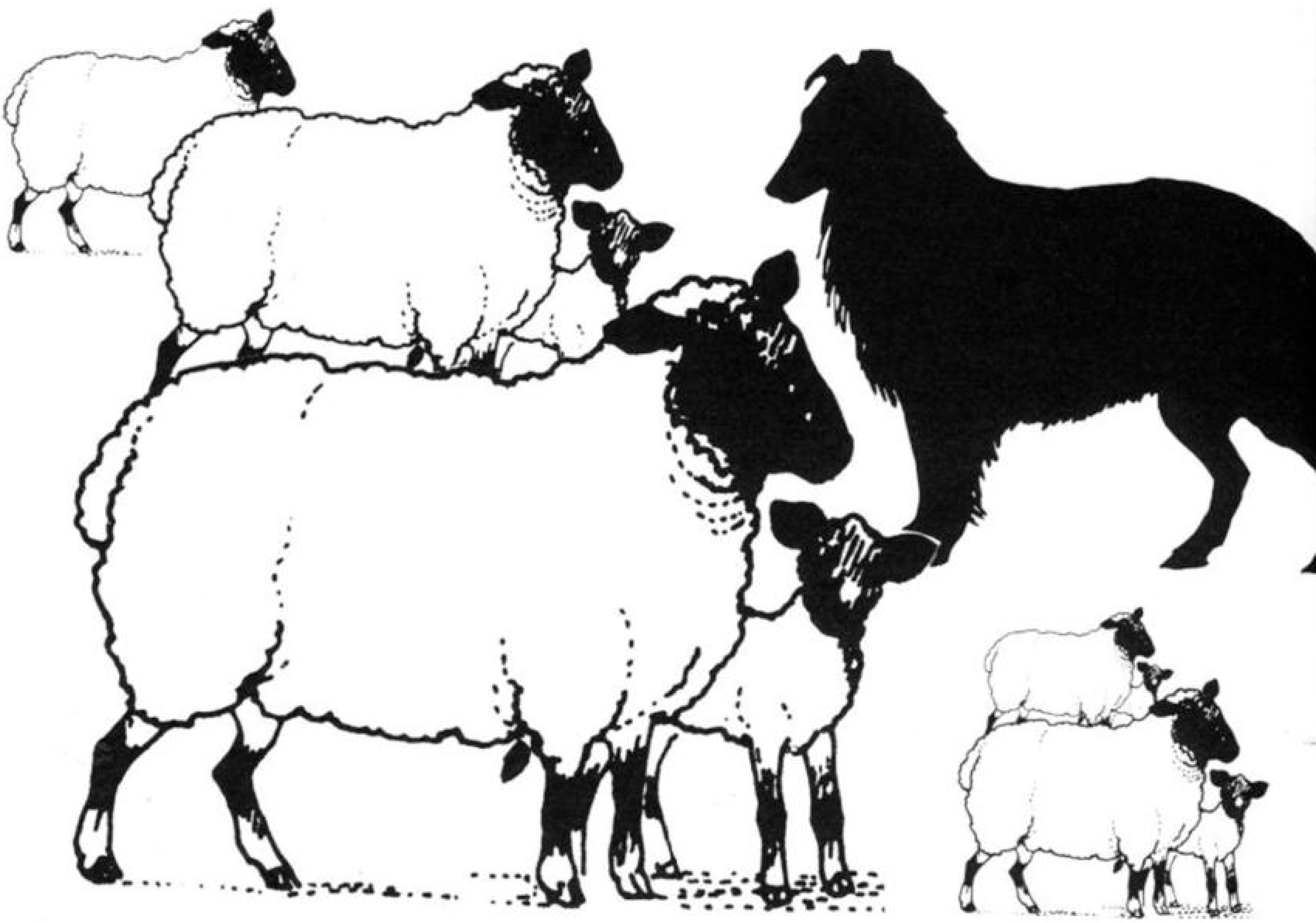
Address ....

....

Credit card holder's signature

Sheepdog trial

Round up your sheep with this program for your 16K ZX81 from Guy Morgan of Mid-Glamorgan.



The object of this game is to round up a number of sheep in the shortest possible time. You are given the choice of how many sheep (between one and six) you would like to round up; one sheep is fairly easy, but if you choose to round up six sheep you will find it very time consuming as they keep wandering out of the pen as others are being rounded up.

You move the sheep by placing the dog near to the sheep using the cursor keys, so that it will move directly away from the dog. However, if you move too close to the sheep, you may find that the sheep will panic and are liable to move in an unpredictable direction.

The dog is allowed three moves between sheep moves; this can be increased if required by changing line 710. The game ends when the dog has rounded up the sheep and is standing guard at the gate of the pen and the dog's three moves have been completed. At any stage of the game, neither the dog or sheep are allowed to jump the fence or wall of the pen.

It's a dog's life

The dog and sheep are POKEd onto the screen and the previous positions of the characters are blanked by POKEing with zero. The POKE numbers are calcu-

lated as offsets using the number held in the system variable D-FILE as a base point.

The checks on the relationship between sheep and dog are made in terms of x and y co-ordinates, so routines to convert to these are included; they are located at the beginning of the program to speed up the operation. The routine to generate random sheep moves is also placed at the beginning of the program for the same reason. The positions of the sheep in terms of the POKE offsets are held in the array, S(NS).

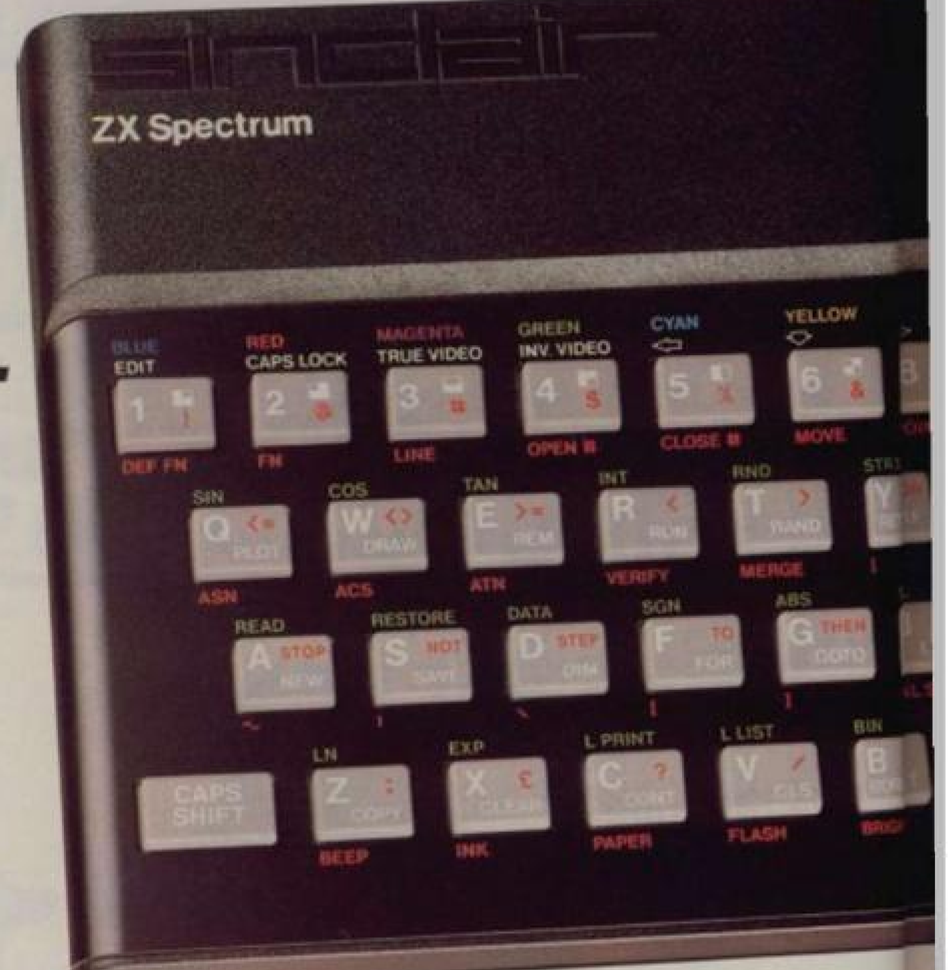
The timer, which is initialised in lines 707 to 709 and updated by the subroutine at line 2010, makes use of the FRAMES system variable. Lines 9000 and 9010 are the usual ZX81 self-RUN routine.

```
   1 REM ***SHEEPDOG TRIAL***
   9 REM ***RULES***
  10 PRINT AT 0,10;"SHEEPDOG TRIAL"
  20 PRINT AT 2,0;"YOU MAY CHOOSE HOW MANY SHEEP TO","ROUND UP. NO MORE THAN 6. IF","YOU GET TOO CLOSE TO A SHEEP IT ","WILL PANIC AND IF YOU ARE TOO","FAR AWAY SHEEP WILL WANDER AT ","RANDOM."
  25 PRINT "MOVE DOG WITH THE CURSOR KEYS.",,"TO USE A TURN WITHOUT MOVING","THE DOG PRESS ANY OTHER KEY."
  30 PRINT AT 13,0;"PRESS ANY KEY TO PLAY."
  40 IF INKEY$="" THEN GOTO 40
  50 CLS
  90 GOTO 300
 100 REM ***CONV. TO CO-ORDS***
 110 LET YS=INT (Z/33)+1
 120 LET XS=(Z-(YS-1)*33)
 130 RETURN
 140 REM ***DOG CO-ORDS***
 150 LET YD=INT (D/33)+1
 160 LET XD=(D-(YD-1)*33)
 170 RETURN
 180 REM ***RANDOM MOVE***
 190 LET XS=XS+1-INT (RND*3)
 200 LET YS=YS+1-INT (RND*3)
 210 GOTO 865
 220 REM ***CONV. TO POKE NO.***
 230 LET WS=XS+33*(YS-1)
 240 RETURN
 300 REM ***NO. OF SHEEP***
 310 PRINT "HOW MANY SHEEP DO YOU WANT ","TO ROUND UP?"
 315 INPUT NS
 320 IF NS>0 AND NS<7 THEN GOTO 340
 325 PRINT ,,"SORRY, MORE THAN 0 AND LESS","THAN 7"
 330 GOTO 315
 340 PRINT ,,NS;" IS OKAY."
 345 FOR N=1 TO 100
 346 NEXT N
 350 CLS
 355 REM ***INITIALIZE***
 360 DIM S(NS)
 410 REM ***PEN***
 420 PRINT AT 9,13;"▛▀  ▀▜"
 430 PRINT AT 10,13;"▌    ▐"
 440 PRINT AT 11,13;"▌    ▐"
 450 PRINT AT 12,13;"▙▄▄▄▄▟"
 460 REM ***FENCE***
 470 FOR N=0 TO 31
 480 PRINT AT 0,N;".";AT 21,N;".";
 490 NEXT N
 500 FOR N=0 TO 21
 510 PRINT AT N,0;".";AT N,31;".";
 520 NEXT N
 530 REM ***GENERATE SHEEP***
 535 LET W=PEEK 16396+256*PEEK 16397
 540 FOR N=1 TO NS
 550 LET WS=INT (RND*724)
 560 IF PEEK (W+WS)<>0 THEN GOTO 550
 570 POKE W+WS,20
 580 LET S(N)=WS
 590 NEXT N
 600 REM ***PLACE DOG***
 610 LET WD=INT (RND*724)
 620 IF PEEK (WD+W)<>0 THEN GOTO 610
 630 POKE WD+W,8
 640 LET D=WD
 700 REM ***START***
 707 LET S=0
 708 POKE 16436,255
 709 POKE 16437,255
 710 FOR N=1 TO 3
 715 LET D1=D
 720 IF INKEY$="" THEN GOTO 720
 730 IF INKEY$="8" THEN LET D=D+1
 740 IF INKEY$="5" THEN LET D=D-1
 750 IF INKEY$="6" THEN LET D=D+33
 760 IF INKEY$="7" THEN LET D=D-33
 770 IF PEEK (W+D)<>0 THEN LET D=D1
 780 POKE W+D1,0
 790 POKE W+D,8
 800 NEXT N
 810 REM ***MOVE SHEEP***
 815 GOSUB 140
 820 FOR N=1 TO NS
 830 LET Z=INT (S(N))
 835 GOSUB 100
 840 IF ABS (XS-XD)>3 OR ABS (YS-YD)>3 THEN GOTO 180
 843 IF ABS (XS-XD)<2 AND ABS (YS-YD)<2 THEN GOTO 180
 845 IF XS>XD THEN LET XS=XS+1
 850 IF XS<XD THEN LET XS=XS-1
 855 IF YS>YD THEN LET YS=YS+1
 860 IF YS<YD THEN LET YS=YS-1
 865 GOSUB 220
 870 IF PEEK (W+WS)<>0 THEN GOTO 900
 875 POKE W+S(N),0
 880 POKE W+WS,20
 885 LET S(N)=WS
 900 NEXT N
 910 REM ***ALL IN PEN?***
 915 LET P=0
 920 FOR N=345 TO 347
 925 IF PEEK (W+N)=20 THEN LET P=P+1
 930 IF PEEK (W+N+33)=20 THEN LET P=P+1
 935 IF P=NS THEN GOTO 1030
 940 NEXT N
 943 GOSUB 2010
 945 GOTO 710
1000 REM ***END OF GAME***
1010 GOSUB 2010
1022 GOTO 1040
1025 REM ***DOG IN GATE?***
1030 IF PEEK (W+313)=8 THEN GOTO 1000
1035 GOTO 710
1040 LET TM=INT (S/60)
1045 LET TS=INT (S-TM*60)
1050 PRINT AT 18,1;NS;" SHEEP IN ";TM;" MIN";
1055 IF TM<>1 THEN PRINT "S";
1060 PRINT AT 18,18;" AND ";TS;" SECS"
1070 STOP
2010 LET S=S+(256*(255-PEEK 16437)+PEEK 16436)/50
2020 POKE 16437,255
2030 POKE 16436,255
2040 RETURN
9000 SAVE "SHEEPDOG"
9010 GOTO 1
```

Sinclair ZX Spectrum

16K or 48K RAM... full-size moving-key keyboard... colour and sound... high-resolution graphics...

From only £125!



First, there was the world-beating Sinclair ZX80. The first personal computer for under £100.

Then, the ZX81. With up to 16K RAM available, and the ZX Printer. Giving more power and more flexibility. Together, they've sold over 500,000 so far, to make Sinclair world leaders in personal computing. And the ZX81 remains the ideal low-cost introduction to computing.

Now there's the ZX Spectrum! With up to 48K of RAM. A full-size moving-key keyboard. Vivid colour and sound. High-resolution graphics. And a low price that's unrivalled.

Professional power– personal computer price!

The ZX Spectrum incorporates all the proven features of the ZX81. But its new 16K BASIC ROM dramatically increases your computing power.

You have access to a range of 8 colours for foreground, background and border, together with a sound generator and high-resolution graphics.

You have the facility to support separate data files.

You have a choice of storage capacities (governed by the amount of RAM). 16K of RAM (which you can uprate later to 48K of RAM) or a massive 48K of RAM.

Yet the price of the Spectrum 16K is an amazing £125! Even the popular 48K version costs only £175!

You may decide to begin with the 16K version. If so, you can still return it later for an upgrade. The cost? Around £60.

Ready to use today, easy to expand tomorrow

Your ZX Spectrum comes with a mains adaptor and all the necessary leads to connect to most cassette recorders and TVs (colour or black and white).

Employing Sinclair BASIC (now used in over 500,000 computers worldwide) the ZX Spectrum comes complete with two manuals which together represent a detailed course in BASIC programming. Whether you're a beginner or a competent programmer, you'll find them both of immense help. Depending on your computer experience, you'll quickly be moving into the colourful world of ZX Spectrum professional-level computing.

There's no need to stop there. The ZX Printer – available now – is fully compatible with the ZX Spectrum. And later this year there will be Microdrives for massive amounts of extra on-line storage, plus an RS232 / network interface board.



Key features of the Sinclair ZX Spectrum

- Full colour – 8 colours each for foreground, background and border, plus flashing and brightness-intensity control.
- Sound – BEEP command with variable pitch and duration.
- Massive RAM – 16K or 48K.
- Full-size moving-key keyboard – all keys at normal typewriter pitch, with repeat facility on each key.
- High-resolution – 256 dots horizontally x 192 vertically, each individually addressable for true high-resolution graphics.
- ASCII character set – with upper- and lower-case characters.
- Teletext-compatible – user software can generate 40 characters per line or other settings.
- High speed LOAD & SAVE – 16K in 100 seconds via cassette, with VERIFY & MERGE for programs and separate data files.
- Sinclair 16K extended BASIC – incorporating unique 'one-touch' keyword entry, syntax check, and report codes.

ctum



The ZX Printer – available now

Designed exclusively for use with the Sinclair ZX range of computers, the printer offers ZX Spectrum owners the full ASCII character set – including lower-case characters and high-resolution graphics.

A special feature is COPY which prints out exactly what is on the whole TV screen without the need for further instructions. Printing speed is 50 characters per second, with 32 characters per line and 9 lines per vertical inch.

The ZX Printer connects to the rear of your ZX Spectrum. A roll of paper (65ft long and 4in wide) is supplied, along with full instructions. Further supplies of paper are available in packs of five rolls.

The ZX Microdrive – coming soon

The new Microdrives, designed especially for the ZX Spectrum, are set to change the face of personal computing by providing mass on-line storage.

Each Microdrive can hold up to 100K bytes using a single interchangeable storage medium.

The transfer rate is 16K bytes per second, with an average access time of 3.5 seconds. And you'll be able to connect up to 8 Microdrives to your Spectrum via the ZX Expansion Module.

A remarkable breakthrough at a remarkable price. The Microdrives will be available in the early part of 1983 for around £50.





ZX Spectrum software on cassettes – available now

The Spectrum software library is growing every day. Subjects include games, education, and business/household management. Flight Simulation...Chess...Planetoids...History...Inventions...VU-CALC...VU-3D...Club Record Controller...there is something for everyone. And they all make full use of the Spectrum's colour, sound, and graphics capabilities. You'll receive a detailed catalogue with your Spectrum.

ZX Expansion Module

This module incorporates the three functions of Microdrive controller, local area network, and RS232 interface. Connect it to your Spectrum and you can control up to eight Microdrives, communicate with other computers, and drive a wide range of printers.

The potential is enormous, and the module will be available in the early part of 1983 for around £30.

sinclair

Sinclair Research Ltd, Stanhope Road, Camberley, Surrey GU15 3PS. Tel: Camberley (0276) 685311.

How to order your ZX Spectrum

BY PHONE – Access, Barclaycard or Trustcard holders can call 01-200 0200 for personal attention 24 hours a day, every day. BY FREEPOST – use the no-stamp needed coupon below. You can pay by cheque, postal order, Barclaycard, Access or Trustcard.

EITHER WAY – please allow up to 28 days for delivery. And there's a 14-day money-back option, of course. We want you to be satisfied beyond doubt – and we have no doubt that you will be.

To: Sinclair Research, FREEPOST, Camberley, Surrey, GU15 3BR. **Order**

Qty	Item	Code	Item Price £	Total £
	Sinclair ZX Spectrum – 16K RAM version	100	125.00	
	Sinclair ZX Spectrum – 48K RAM version	101	175.00	
	Sinclair ZX Printer	27	59.95	
	Printer paper (pack of 5 rolls)	16	11.95	
	Postage and packing: orders under £100	28	2.95	
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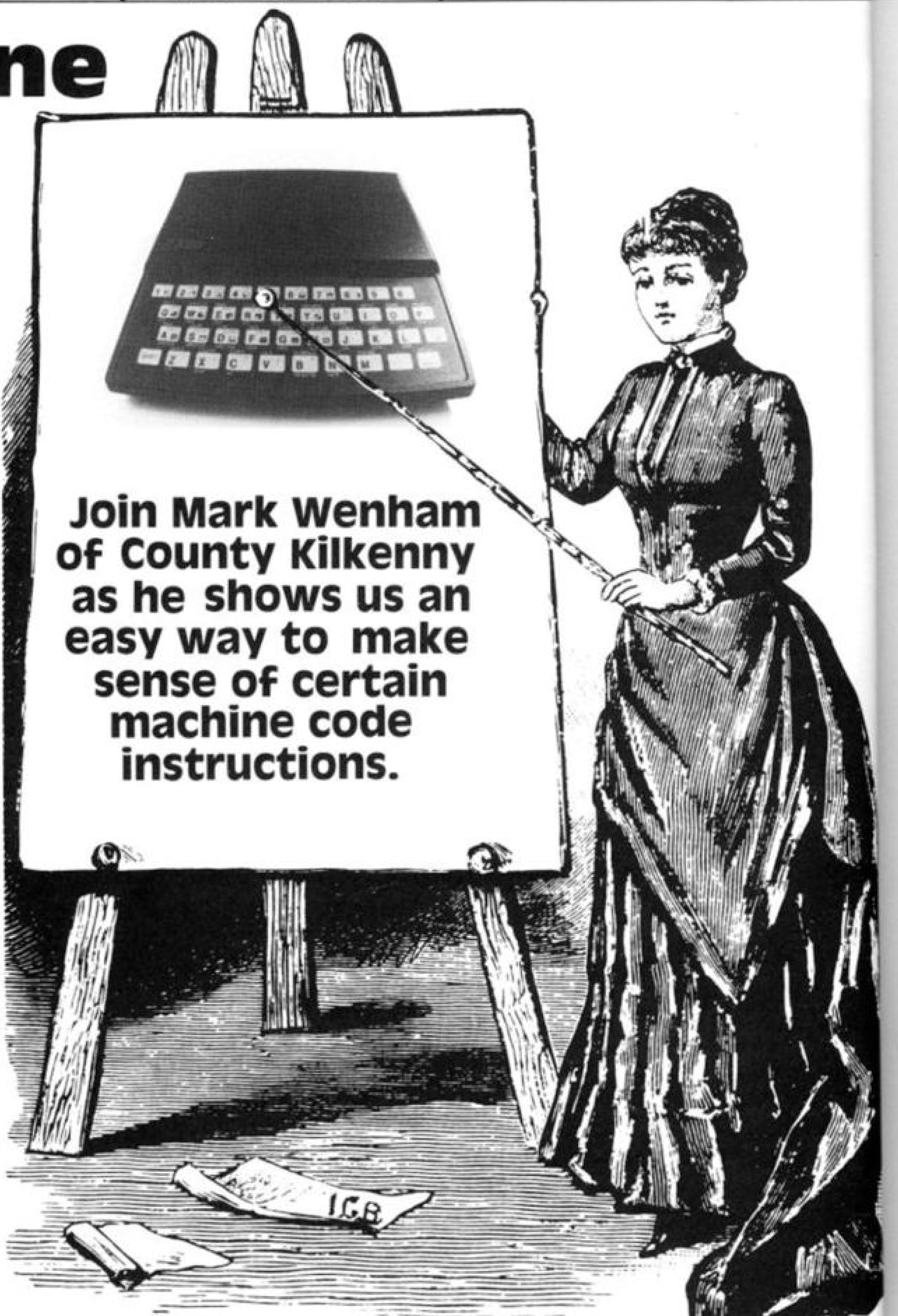
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Machine code tutor



This program is aimed at those who, like myself, get tired of writing out strings of 1s and Os in order to work out the effect of certain machine code instructions. The program is menu driven and covers 25 instructions. These are:

ADC A,X	CPL	RRC A
ADD A,X	DAA	SLA A
SBC A,X	RLA	SRA A
AUB A,X	RRA	SRL A
AND X	RLCA	NEG
OR X	RRCA	RLD
XOR X	RL A	RRD
DEC A	RR A	
INC A	RLC A	

Inputs can be made in binary, decimal and Hex; outputs are expressed in the same way.

The program shows all flags (some instructions do not affect certain flags, hence the inclusion of both RRCA and RRC A, etc). The results of the last instruction may be carried forward to the next instruction, and the flags register is saved and restored between instructions allowing the sequence of instructions to be 'executed'.

Using it

Once you have the machine code tutor (MCT) program up and running, the menu is printed on the screen. Then, enter the letter corresponding to the instruction you would like to see. When the next prompt, A=, appears, enter any number between O and 255. The same applies for the prompts, X= and (HL)=.

For binary and Hex inputs, the input strings should start with a 'B' or an 'H' respectively followed by at least two digits (see Appendix A of the Sinclair manual for a list of the legal Hex numbers). Binary numbers may be any combination of 1s and Os; it should be noted that only the first eight digits of these will be used by the program, ie BO1 will equate to OOOOOOO1 and BOOOOOOOO1 will equate to OOOOOOOO.

The flags used in the program are as follows:

16514	1E00		LD E,00	Number to be converted is POKEd into 16515
	0608		LD B,08	
	CB13	LOOP	RL E	Rotate number to left
	3804		JR C+4	if left most bit is '1'
	3E1C		LD A, "0"	ELSE
	1802		JR +2	
	3E1D		LD A, "1"	
	D7		RST 10	PRINT CHR$ held in a register
	10F3		DJNZ LOOP	
	C9		RET	

The machine code listing for decimal to binary.

S — Sign.
Z — Zero.
– — Not used.
H — Half carry.
P — Parity/overflow
N — Subtract.
C — Carry.

To get the program running, simply enter and RUN the loader program. Then, delete lines 10-130 (high numbers first) and enter line 10 of MCT. In line 10 is not listed in Command mode, try the following:

LIST 10
POKE 16419,10

and then CONTINUE.

The variables used in the programs are:

A$ — Input (and decimal output) string.
B$ — Is equal to A$ (2 TO) if A$ is binary.
C$ — Hex codes of machine code instructions.
E$ — Hex codes of second byte of two byte instructions.
I$ — Mnemonic for C$ and/or E$.
Q$ — Hex output string.
Z$ ← TR$ of the last output
A — VAL A$.
DF — Start of the display file.
L — Menu number (code A$ — 37) of the current instruction.
W — Pointer (to find I$ in the display file).

Here is a list of addresses which can be PEEKed.

PEEK 16507 — (HL).
PEEK 16508 — Flags register.
PEEK 16579 — First byte of a machine code instruction.
PEEK 16580 — Second byte of a machine code instruction (or second operand — X,(HL)).
PEEK 16578 — Accumulator.
PEEK 16515 — VAL A$ (decimal to binary).

Here is a list of the entry points to the various routines:

USR 16514 — Decimal to binary.
USR 16532 — Binary to decimal.
USR 16570 — Carry out instruction.
USR 16589 — Print menu.

And finally, here is a breakdown of the MCT program.

Lines 100-290 Input subroutine.
Lines 110-150 Idiot proofing.
Line 170 Hex input.
Lines 190-200 Binary input.
Lines 300-430 Print menu — input choice.
Lines 380-400 Get mnemonic.
Lines 480-660 Input operands and print them. Carry out instructions and prints the result.

```
16532   2A1040          LD HL, (VARS)
        3E47            LD A, 71d       (71 = B$)
        EDB1            CPIR            Look for B$
        E0              RET PO          if not found
        7E              LD A, (HL)      get length of string
        FE08            CP08
        3802            JR C + 2
        3E08            LD A,08         IF LEN B$ > 8, ignore B$(9 TO)
        47              LD B,A
        5F              LD E, A
        23              INC HL
        23              INC HL          Move to start of string
        E5              PUSH HL         Save it
        7E      LOOP    LD A, (HL)
        D61C            SUB 28d         Strip ZX "0" (try PRINT B$
        77              LD (HL),A       after binary input)
        23              INC HL
        10F9            DJNZ LOOP       From 1st eight (or less) CHR$
        E1              POP HL          Get start of string
        43              LD B,E          1st eight CHR$ of B$ are now
        05              DEC B           CHR$ 0 or CHR$ 1
        7E              LD A,(HL)
        17      LOOP 2  RLA             Move these 'bits' into
        23              INC HL          a register
        86              ADD A,(HL)
        10FB            DJNZ LOOP 2
        4F              LD C,A          (B = 0)
        C9              RET
```

The machine code listing for binary to decimal.

```
16570   217C40          LD HL,165 08
        4E              LD C,(HL)       Get flags from last result
        C5              PUSH BC         and
        F1              POP AF          put them in the flags register
        2B              DEC HL          (16507 = "(HL)")
        3E00            LD A,00         ← 16578
        00              NOP             ← 16579
        00              NOP             ← 16580
        F5              PUSH AF
        C1              POP BC
        23              INC HL
        71              LD (HL),C       Save flags for next time
        48              LD C,B
        0600            LD B,00
        C9              RET
```

The machine code listing for instruction.

```
16589   21D840          LD HL,16600     Start of B$ in loader program
        7E      LOOP    LD A,(HL)       Get character
        FEFF            CP FF           If "COPY"
        C8              RETZ            then return
        D7              RST10           else PRINT CHR$
        23              INC HL
        18F8            JR LOOP
16600   INSTRUCTIONS ARE .................
```

The machine code listing for print.

```
1  REM 317 CHR$,PEEK 16830=CODE OF LAST CHR$
10 LET X= 16514
20 LET A$ = "1E00 0608 CB13 3804 3EIC 1802 3E1D
   D7 10F3 C9 2A1040 3E47 EDB1 E07E FE08 3802
   3E08 475F 2323 E5 7E D61C 77 23 10F9 E1 43 05
   7E 17 23 86 10FB 4F C9"
30 LET A$= A$ + "217C40 4E C5 F1 2B 3E00 00
   00F5 C1 23 71 48 0600 C9 21D8 40 7E FEFF C8 D7
   23 18F8"
33 REM LEN A$ = 172
40 FOR F= 1 to LEN A$-1 STEP 2
50 POKE X, 16 * CODE A$(F) + CODE A$(F+1) — 476
```



It can take the genius of Pythagorus, and the patience of Job, to succeed with machine code.

```
60   LET X = X + 1
70   NEXT F
80   LET B$ = "INSTRUCTIONS   ARE: * * A)ADC   A,X
       N)RLCA * B) ADD   A,X   O)RRCA * C) SBC
       A,X   P)RL   A * D) SUB   A,X   Q)RR   A * E)
     AND   X         R)RLC   A * F) OR   X         S)
     RRC   A * G) XOR   X         T) SLA   A * H) DEC
       A            U) SRA     A * I) INC   A         V)
     SRL   A * J) CPL               W) NEG * K) DAA
                X) RLD * L) RLA                Y) RRD * M)
     RRA COPY"
88   REM LEN B$ = 231
90   FOR F = 1 TO LEN B$
100  POKE X, CODE B$ (F)
110  IF B$ (F) = " * " THEN POKE X, 118
120  LET X = X + 1
130  NEXT F
```

Machine code loader program.

```
00   REM DO NOT CHANGE PRINT STATEMENTS:
     280/480/520/560
10   DIM I$(5)
20   LET Z$ = "0"
30   LET C$ = "CE C6 DE D6 E6 F6 EE 3D 3C 2F 27 17 1F
     07 0F CB CB CB CB CB CB CB ED ED ED"
35   POKE 16508, 0
40   GO TO 300
100  INPUT A$
110  IF A$ < "0" THEN GOTO 100
120  IF A$ = "S" THEN LET A$ = Z$
130  IF A$ < "A" AND A$ (LEN A$) < "A" THEN GOTO
     100 + 120 * (VAL A$ < 256)
140  IF A$ (1) <> "H" AND A$(1) <> "B" THEN GOTO
     100
150  IF LEN A$ < 3 OR A$ (1 + (LEN A$ > 2)) > "F" OR
     A$ (LEN A$) > "F" THEN GOTO 100
160  IF A$ < "H" THEN GOTO 190
170  LET A = 16 * CODE A$ (2) + CODE A$ (3) - 476
180  GOTO 230
190  LET B$ = A$ (2 TO)
200  LET A = USR 16532
210  GO TO 230
220  LET A = VAL A$
230  LET A$ = STR$A
240  LET Q$ = CHR$ (INT(A/16) + 28) + CHR$ (A - 16 *
     INT (A/16) + 28) + "[H]"
250  LET A$ = "00" (TO (A < 10) + (A < 100)) + A$
260  POKE 16515, A
270  RAND USR 16514
280  PRINT " = "; A$; " = "; Q$
290  RETURN
300  LET DF = PEEK 16396 + 256 * PEEK 16397
310  LET E$ = "17 1F 07 0F 27 2F 3F 44 6F 67"
320  RAND USR 16589
325  PRINT,, "     ENTER A - Y"
330  INPUT A$
340  IF A$ < "A" OR A$ > "Y" THEN GOTO 330
350  LET L = CODE A$ - 37
360  LET W = 1 + L - 13 * (A$ > "M")
370  LET DF = DF + 3 + 33 * W + 10 * (A$ > "M")
380  FOR F = 1 TO LEN I$
390  LET I$ = CHR$ PEEK (DF + F - 1)
400  NEXT F
410  LET W = L * 2 - 1
420  IF A$ > "O" THEN LET E$ = E$ (W - 30 TO W -
     29)
430  CLS
440  PRINT I$; ",X" (TO 2 * (A$ < "E")); " = "; C$ (W
     TO W + 1); E$ (TO 2 * (A$ > "O")); " [H] "
450  POKE 16579, 16 * CODE C$(W) + CODE C$ (W +
     1) - 476
460  POKE 16580, (16 * CODE E$ + CODE E$ (2) - 476)
     * (A$ > "O")
470  PRINT AT 15, 0; "TO USE LAST RESULT ENTER S ","
     START BINARY WITH B/HEX WITH H"
480  PRINT AT 4, 2; "A = ";
490  GOSUB 100
500  POKE 16578, A
510  IF L > 7 THEN GOTO 550
520  PRINT "  X = ";
530  GOSUB 100
540  POKE 16580, A
550  IF L < 24 THEN GOTO 590
560  PRINT "(HL) = ";
570  GOSUB 100
580  POKE 16507, A
590  LET A = USR 16570
600  PRINT AT 7, 0; "□A = ";
610  GOSUB 230
620  LET Z$ = A$
630  IF L   24 THEN GOTO 665
640  LET A = PEEK 16507
650  PRINT "(HL) = ";
660  GOSUB 230
665  PRINT,, "FLAGS SZ - H - PNC"
670  PRINT "      ";
675  POKE 16515, PEEK 16508
680  RAND USR 16514
685  IF PEEK 16508 > = 128 THEN PRINT "  (A = "; VAL
     Z$ - 256; ")"
690  PRINT AT 19, 0; "ANY KEY TO CONTINUE", "£ TO
     STOP"
695  IF INKEY$ = "" THEN GOTO 695
700  CLS
705  GOTO 300
```

Machine code tutor (MCT) program.

F.A. Cup



Get on the road to Wembley with this football simulation written by GL Maynard.

This program was written to provide as realistic a simulation as possible of football's biggest annual spectacle.

The 124 teams entering the competition are allotted classes from one to six; one being for Division One, two for Division Two, and so on; classes five and six are reserved for amateurs. The 92 football league teams are compulsory for the competition, but the amateur teams may be chosen by the user.

On the ball

The teams, together with their classes, can be typed in once the whole program has been entered into the computer by typing RUN 8000. Lines 8000 to 9140 comprise the team input routine; the user is asked to INPUT the team names, followed by the class of the team. It must be noted that the First Division teams must be typed in first, followed by the Division Two teams, and so on.

Once all the teams have been typed in, lines 8000 to 9140 can be deleted and the program SAVEd. For this, try typing in SAVE "f.a. cup" LINE 40; this will allow the program to RUN automatically without obliterating the names of all the teams and their respective classes.

When the game has been successfully LOADed, the program will stop to allow the user to type RAND, followed by GOTO 50. This ensures that the same draws do not crop up again and again (which tends to happen if RAND is incorporated into the program).

Match of the day

The rounds are drawn, displayed and played one by one. Lines 150 to 210 ensure that First and Second Division teams are excluded from the first two rounds of the competition, while line 245 admits these 44 teams to round three.

Lines 450 to 510 make sure that the results of the games reflect the classes of the teams. The draws for each round are made in lines 266 to 300. Lines 550 to 750 comprise the routine which checks for replays, and then plays them.

Below is a list of the variables used in the program and a brief explanation of their function.

a — Loop variable.
a$ — Array; dimensioned (124, 14) — Team names of up to 14 characters.
c — Array; dimensioned

(124) — Team classes, one to six.

d — Array; dimensioned (124) — If d is equal to zero then the team is out or excluded; if d is equal to one then the team is through or admitted to the next round; and if d is equal to two then the game must be replayed.

e — Array; dimensioned (124) — Selected randomly in the draw. Also allows the draw to be made.

f — The away team score.

dif — The difference in classes of the two teams playing.

diff — The difference in classes as read from the DATA in line 475.

r — The round number.

s — The number of teams in a round.

u — Loop variable.

t — If the value of t is equal to zero then there are no replays.

home — The possible magnitude of the home team's score as read from the DATA in line 475.

away — The possible magnitude of the away team's score as read from the DATA in line 475.

When the program is in use, the player will have to wait for a few seconds while the draw is made at the beginning of each round. Then, as the user presses Enter, a new score will be displayed on the screen.

```
  10 REM F.A. CUP GAME
  30 REM preliminaries
  40 CLS : PRINT AT 10,0;"type R
AND then GOTO 50": STOP
  50 POKE 23609,60: BORDER 4: IN
K 7: PAPER 2: BRIGHT 0
 150 REM exclude divs. 1-2
 180 CLS : FOR a=1 TO 124
 190 LET d(a)=0
 200 IF c(a)=4 OR c(a)=5 OR c(a)
=6 THEN LET d(a)=1
 210 NEXT a
 215 REM main game loop
 220 FOR r=1 TO 8
 221 BORDER INT (RND*8): INK INT
 (RND*8): PAPER 9
 222 BEEP .1,3: BEEP .2,2: BEEP
.2,1: BEEP .2,0
 224 IF r=8 THEN PRINT FLASH 1;
INK INT (RND*8); PAPER 9;AT 17,0
;"The final draw is about to be
   made": GO TO 230
 225 PRINT FLASH 1; INK INT (RND
*8); PAPER 9;AT 17,0;"The draw f
or round ";r;" is about tobe mad
e"
 230 IF r=1 OR r=2 THEN LET s=80
/r
 235 IF r>2 THEN LET s=64/(2↑(r-
3))
 240 IF r<>3 THEN GO TO 266
 242 REM admit 1st & 2nd div. te
ams
 245 FOR a=1 TO 44: LET d(a)=1:
NEXT a
 260 REM draw
 266 FOR a=1 TO s
 270 LET e(a)=INT (RND*124)+1
 280 IF d(e(a))=0 THEN GO TO 270
 290 LET d(e(a))=0
 300 NEXT a
 310 CLS
 315 IF r=8 THEN PRINT "FINAL DR
AW": GO TO 340
 320 PRINT "Draw for round ";r'
 330 REM printout of draw
 350 FOR a=1 TO s-1 STEP 2
 390 PRINT INK INT (RND*8); PAPE
R 9;a$(e(a));" v ";a$(e(a+1))
 395 BEEP .05,2.45
 400 NEXT a
 410 PAUSE 989
 420 CLS
 425 IF r=8 THEN PRINT "F.A. CUP
 FINAL : AT WEMBLEY"''': GO TO 4
35
 430 PRINT "Round ";r'
 435 BEEP .2,4: BEEP .15,1
 440 REM scores & score printout
routine
 450 FOR a=1 TO s-1 STEP 2
 455 BEEP .1,-1: BEEP .1,-3
 460 INPUT INK 7; PAPER 2; FLASH
1;"ENTER for next result"; LINE
i$
 470 LET dif=c(e(a))-c(e(a+1))
 475 DATA -5,9.1,1.6,-4,7.2,2.05
,-3,6.2,2.45,-2,4.7,3.1,-1,4.35,
3.65,0,4.35,4.1,1,4,4.2,2,3.5,4.
4,3,3.2,5.05,4.3.05,5.2,5.2.05,7
.15
 480 RESTORE 475
 490 FOR u=1 TO 11: READ diff,ho
me,away
 500 IF diff=dif THEN LET e=INT
(RND*home): LET f=INT (RND*away)
: GO TO 560
 510 NEXT u
 550 REM replays
 560 IF d(e(a))=2 THEN RETURN
 600 PRINT a$(e(a));e;" ";a$(e(a
+1));" ";f
 610 IF e>f THEN LET d(e(a))=1
 620 IF f>e THEN LET d(e(a+1))=1
 630 IF e=f THEN LET d(e(a))=2
 640 NEXT a
 650 LET t=0
 660 FOR a=1 TO s-1 STEP 2
 670 IF d(e(a))=2 THEN LET t=t+1
 680 NEXT a
 690 IF t=0 THEN GO TO 850
 695 PAUSE 150
 700 CLS
 710 PRINT "Replays"
 712 BEEP .15,-2: BEEP .1,0
 715 BEEP .2,2: BEEP .3,1: BEEP
.15,2.4
 720 FOR a=1 TO s-1 STEP 2
 730 IF d(e(a))<>2 THEN GO TO 81
0
 740 IF d(e(a))=2 THEN GO SUB 46
0
 750 IF d(e(a))=2 THEN PRINT a$(
e(a+1));f;" ";a$(e(a));" ";e: BE
EP .05,3: BEEP .1,-5.45
 755 REM set flags after match
 760 LET d(e(a))=0: LET d(e(a+1)
)=0
 780 IF e>f THEN LET d(e(a))=1
 790 IF f>e THEN LET d(e(a+1))=1
 800 IF f=e THEN LET d(e(a))=2
 810 NEXT a
 820 IF t<>0 THEN PAUSE 100
 840 GO TO 650
 842 PAUSE 150
 843 CLS
 850 BEEP .1,2: BEEP .2,-5: NEXT
 r
 860 FOR a=-20 TO 30: BEEP .02,a
: NEXT a
 870 FOR a=30 TO -25: BEEP .015,
a: NEXT a
 900 INPUT FLASH 1;"ENTER for ne
w game"; LINE i$: GO TO 40
7900 REM team and class input ro
utine
8000 DIM a$(124,14): DIM c(124):
 DIM d(124): DIM e(124)
9000 FOR a=1 TO 124
9070 CLS
9080 PRINT AT 0,0;"TEAM ";a
9090 INPUT AT 2,0;"NO MORE THAN
14 CHARACTERS"; LINE a$(a)
9100 CLS
9110 PRINT AT 0,0;"GIVE CLASS 1-
6";AT 2,0;"1-2 : DIV.1"'';"3 : D
IV.2"'';"4 : DIV.3"'';"5 : DIV.4
"'';"6 : AMATEUR"
9120 PRINT AT 16,7;a$(a)
9130 INPUT c(a)
9140 NEXT a
```

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The **Memotech** approach to microcomputing is to take the well-proven and popular ZX81 as the heart of a modular system. This small computer houses the powerful Z80A processing unit and acts as the central processor module through which the **Memopaks** operate.

Memotech has a reputation for professional quality, producing units which are designed to fit perfectly, to look well-balanced, and to work efficiently and reliably.

The modular approach gives ZX81 owners the freedom to design the system they really need. Furthermore, the intercompatibility of the modules ensures that later additions will click straight in, to give you a system that grows with your ambitions and abilities.

To ensure that your expectations are realised, care is taken at every stage to design features into the system to anticipate your needs. For example:
1) Memories are cumulative e.g. 16K and 32K can be added to the **Memopak 16K** or even to the Sinclair 16K RAM pack. **2)** The **HRG** firmware allows commonly used constructions (such as scrolling, shading and labelling graphs), to be called by a few simple commands. **3)** The **Centronics I/F** converts ZX81 character codes into ASCII and extends the print line to the width of the printer, still using the LLIST, LPRINT and COPY commands.

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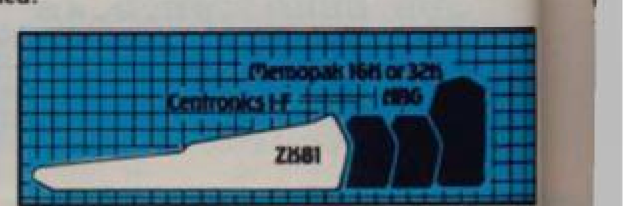
The example system which is shown, on the other hand, would satisfy the needs of someone who wanted to enter data

How it all fits together

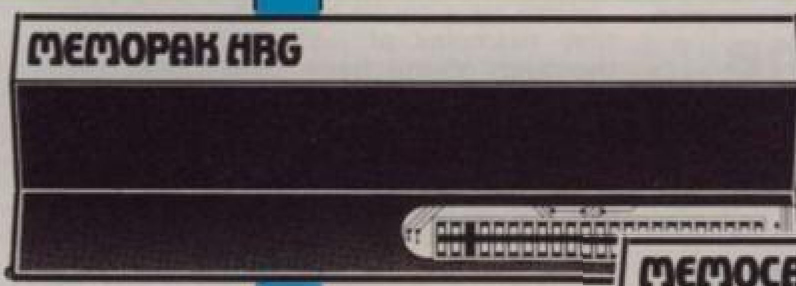
You can see from the diagrams how various Memotech/Sinclair units can be combined.







motech,
ntial of your ZX81...

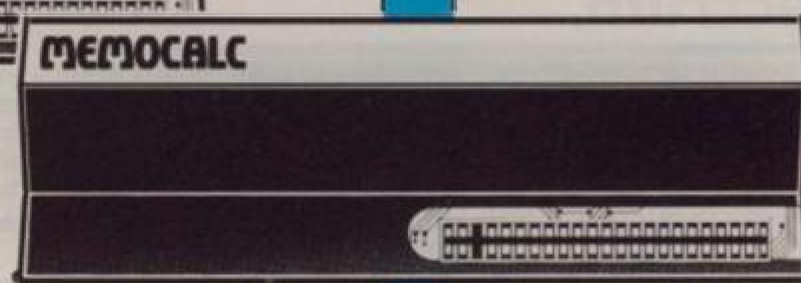


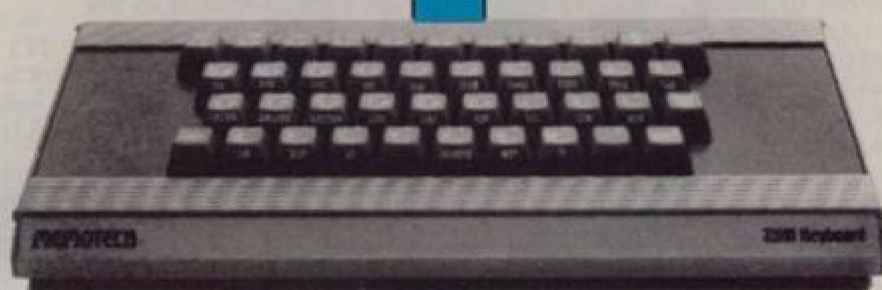
MEMOPAK HRG This pack breaks down the constraints imposed by operating at the ZX81 character level and allows high definition displays to be generated. All 248 × 192 individual pixels can be controlled using simple commands, and the built in software enables the user to work interactively at the dot, line, character, block and page levels. Scrolling, flashing and animation are all here.

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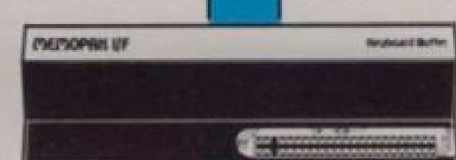


MEMOTECH KEYBOARD

The Memotech plug-in Keyboard plus buffer pack takes the effort out of data entry for ZX81 users. The Keyboard has a light professional touch and is housed in an elegant aluminium case. The simple plug-in system means that you are not obliged to open up your ZX81, use a soldering iron or invalidate your ZX81 warranty.

£49.95 inc VAT





KEYBOARD BUFFER PAK
The Buffer Pak performs a "housekeeping" function for the Keyboard, interfacing directly with the port at the back of your ZX81.

via a light-touch keyboard, construct and label graphs, and then copy the screen to an 80-column printer. Only 16K of memory is shown here but with additional memory, more than one video page can be stored. Up to 7 pages can be displayed in rapid succession to give animated displays.

Looking forward, **Memotech** will continue to back the ZX81 through 1983 with fast storage devices, pressure sensitive electronic drawing boards and more software packs including a **Wordprocessor**, an **RS232 Interface** and a **Z80 Assembler.**

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The learning process

James Walsh studies the new software package from Microl for your ZX Spectrum.

Within a matter of months of the launch of the Spectrum the market had been invaded by books on BASIC programming, written by everyone from software houses to large publishing companies. It is not for me to comment disfavourably on the content of these books, partly as I cannot profess to having read them all, and because there have been no signs that they are not doing their job. But what has, up until now, been forgotten is that not everybody just wants to know how to write programs on the Spectrum, and yet they would probably soon get bored with only playing games. So this is what the Use And Learn book and tape from Microl is trying to remedy.

The 25 BASIC programs in Use And Learn from Microl have been designed to demonstrate the wide ranging potential of the Spectrum, and in conjunction with the manual attempts to improve your programming skills (if that is what you want to do). The Microl package is an excellent way of introducing someone to computers without necessarily baffling them with jargon. For each of the programs there are three sections in the manual:

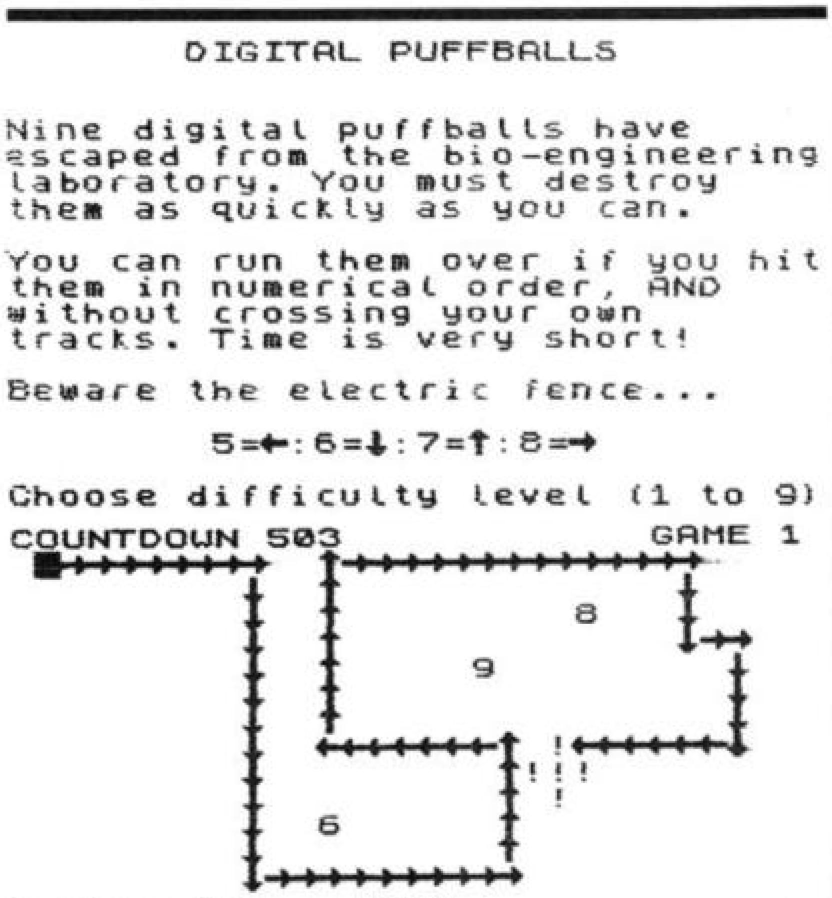
The instructions — which contain clear and precise directions for the use of the programs.
The discussion — which takes you through the structure and interesting points of the program, without actually trying to teach you to be able to copy the program line by line. Any jargon that is used is very carefully and clearly explained. This is something that a lot of books fail to do.
The listing — is also included, so that if you want to look more closely at the program, you can.

Selling a cassette with a book is not completely new (though very few people have done it) and it is a great asset to most users, as the idea of typing long programs in is often daunting and mistakes can easily occur. Quite surprisingly the so-called 'manual' could quite easily be sold on its own as a complete book because of the comprehensive way in which it is set out.

Here are a couple of important examples of just how thorough Microl have been when preparing this package. Because many of the programs use data as part of the program, instructions have been given so that you can expand upon these if you have a 48K machine. Also, where information is stored in arrays, they have arranged for the arrays to be automatically dimensioned to suit the memory size of the Spectrum in use.

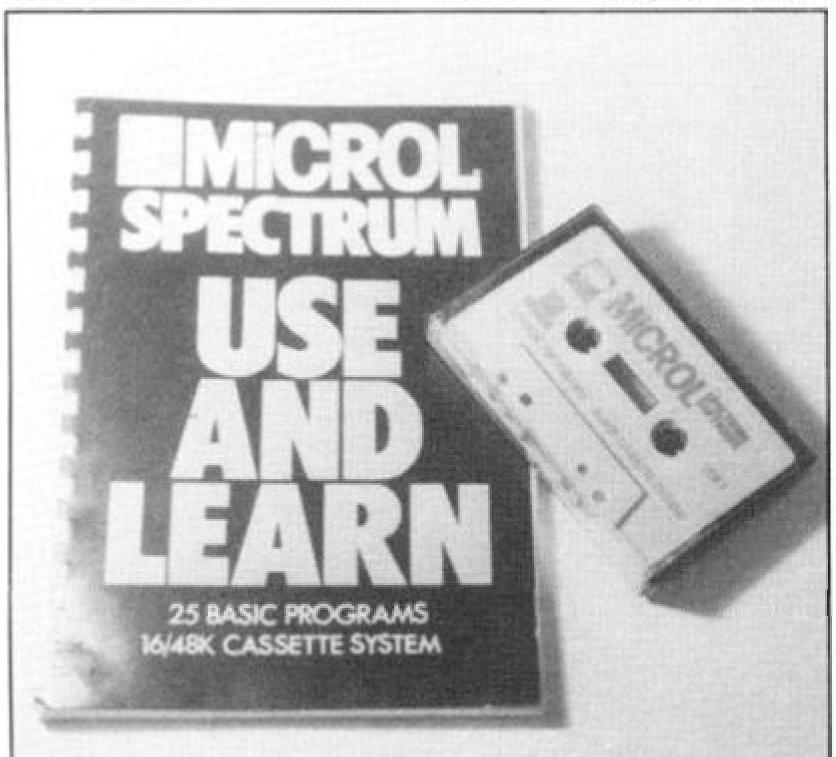
One by one

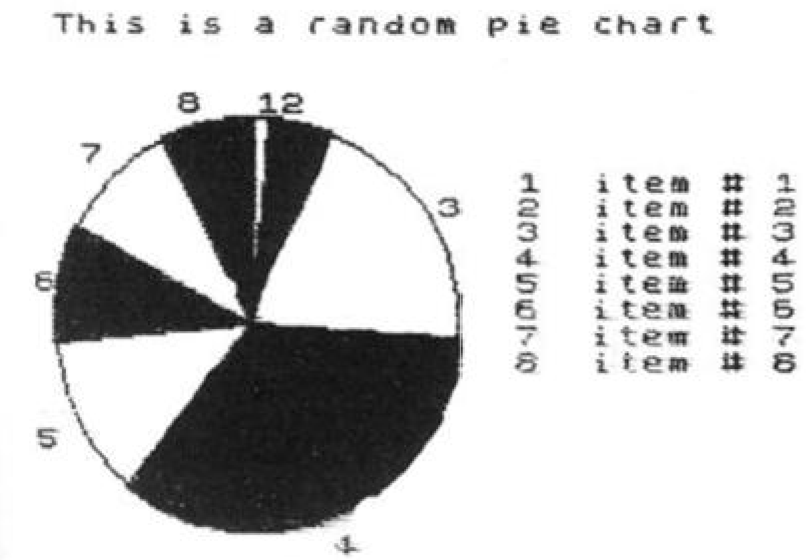
Music allows you to compose and play your own tunes using the screen as a piece of manuscript paper. Positioning of the note is done by moving a yellow cursor up and down the stave. Other operations can also be done via the keyboard and are displayed on the screen. A couple of limitations are that no note shorter than a quaver is allowed, and there is only one length of rest, but apart from that it is great fun to use.
Sentences can only be described as a 'fun' program which generates random sentences on the screen from an internal grammar and vocabulary.
Atlas draws three maps on the screen: the British Isles, Europe and the World. Though this is quite fun, they are far from accurate.
Star Atlas holds 26 constellations on file, which you can either call up as you would do in a reference book, or it can display an unnamed constellation for you to identify.
Convert converts numbers between decimal, binary and hexidecimal. This is a well-designed and useful program though it gets rather inaccurate when you try to convert really enormous numbers.
Clock shows the time on the screen. Boring on its own, but could be integrated into another program and serves well as a demonstration.

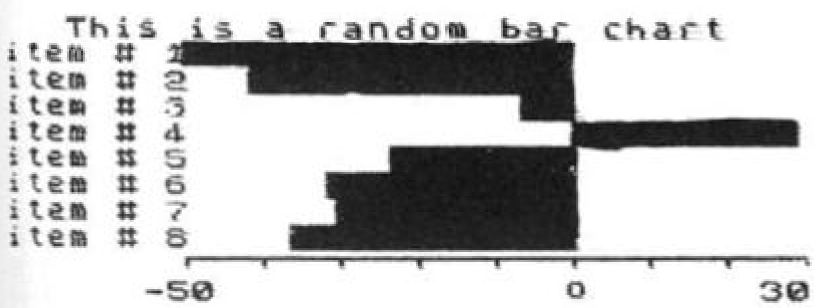


An explosive end to the game, Puffball.

Though the programs on the cassette are not world beating, in that you would not expect to buy them individually, due to the way in which they have been structured and the things that they do, they are not only interesting for a newcomer but also likely to be re-used as time goes on in conjunction with other programs, and to aid programmers in other projects. To do justice to each individual program rather than the book as a whole, I shall give a brief description of each one.







Two random charts from the Graph Drawing Routines program.

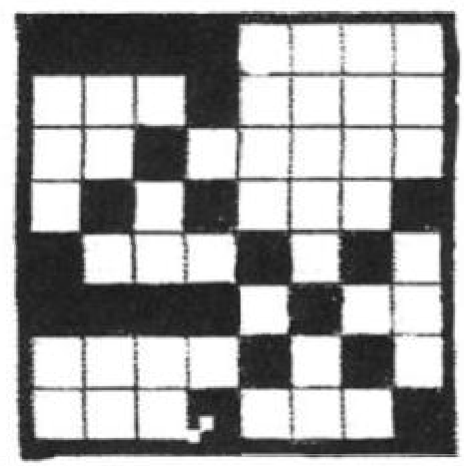
Workbox

This program assumes that you are familiar with the concept of user-defined graphics (see chapter 14 of the manual).

Workbox draws a grid which you use to design your own symbols.

A cursor – ▚ – can be moved around the grid. To black in a square, press 0 (which has the word BLACK above). To whiten a square, press 7. To move the cursor, use I (up), M (down), J (left), and K (right). To end editing, press SPACE.

Press any key when you are ready to start...



MOVE: I=up M=down J=left K=right
EDIT: 7=white 0=black SPACE=end

DATA 240,16,32,81,138,244,10,17

Making 'ZX' into a user-defined graphic, the Workbox way.

Computer Terms Glossary holds the explanations for a range of the most-used computer terms. It is easy to use and particularly useful to the newcomer.

Tapefile is a very simple Database-type of program which can be used to catalogue any kind of cassette.

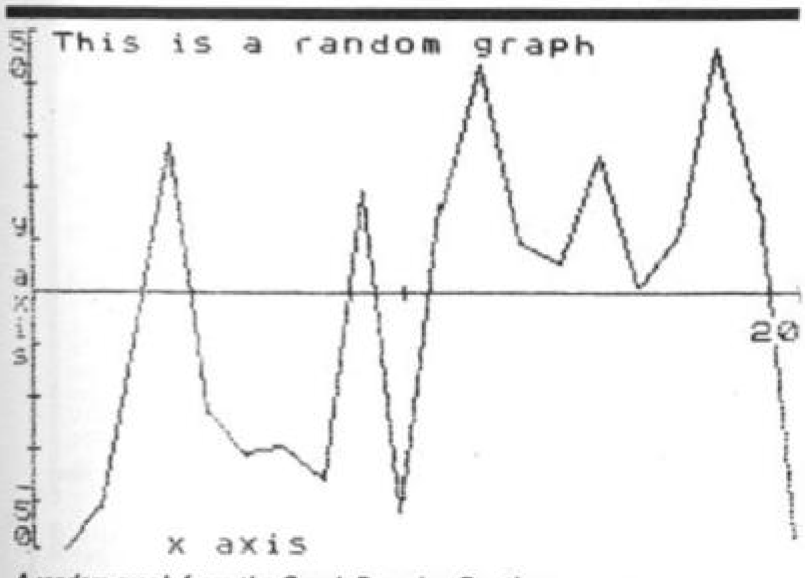
Puffball is a simple but fairly addictive game in which you have to race against time to destroy the nine 'digital puffballs' in the correct order.

use in your own programs, and with the built-in timing routine you can compare their different speeds.

Binsearch is a good binary search routine.

Text Editor allows you to manipulate text on the screen either by keyboard instruction or via a string which has already been entered into the program.

Screen Designer allows you to make screen layout easily onto the screen and juggle them



A random graph from the Graph Drawing Routines program.

Tank is again simple, but is far from easy and is particularly addictive.

Sorts is comprised of three different types of sorting programs which have been arranged for around before the computer turns it into a finished PRINT statement.

Workbox is a useful program to aid the design of user defined characters, which is likely to be useful for any program in which you are going to use UDGs. This program is often invaluable as an aid to better graphics work.

Graph Drawing Routines comprises three programs which have the same general structure; they are: Pie Chart, Bar Chart and Graph. These are another three programs which are likely to be useful and not only within the confines of computer programming.

Memory Map Monitor is only really a one-line program which allows you to test to see how much memory you have left. Through this is an easy routine for a resonably experienced programmer to write, it would not be so for the beginner.

RAM Test checks that all the memory used by the BASIC is working OK.

Addictive Addition is a program to test your basic arithmetic skills; not really that addictive, but what do you expect from maths?

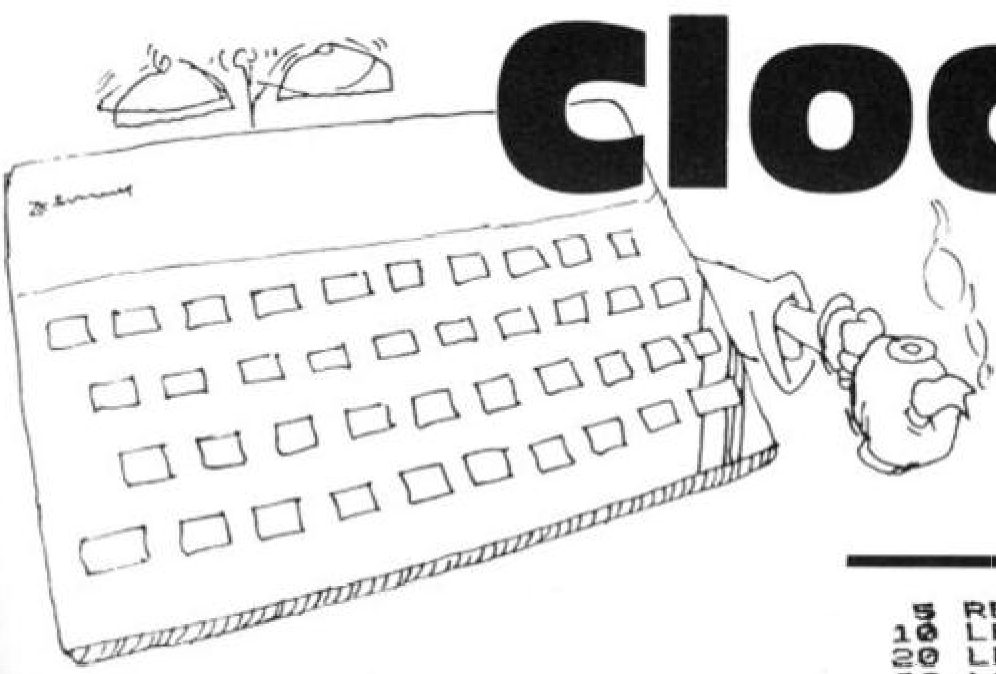
Parachute is a simple game designed to appeal to the younger age group. The idea is to jump out of an aeroplane and open your parachute at the right time to hit the target . . . Fun!

Codebreaker is a game in which you have to decipher a encoded message. Not the most exciting game, but the large vocabulary makes up for it.

Conclusion

Use And Learn is a very professionally produced package. It does the job set out very well and is fantastic value for money, especially for somebody who either wants to further their programming or just wants to know what a computer can do and not necessarily how.

At £9.95, this is very highly recommended indeed. It is available from: TEMPUS, 38 Burleigh Street, Cambridge CB1 1DG



Clocking on

You'll never be late with this program by thirteen year old Ben Rimmer of Eye, Suffolk.

This program has been written for the ZX Spectrum and simulates a digital clock. The listing will not operate on a ZX81 or ZX80, even if you do remove the PAUSE instruction, as they do not work fast enough.

The digital clock produced should be accurate to within one second an hour.

```
  5 REM "TIME"
 10 LET a=0
 20 LET b=0
 30 LET c=0
 40 LET d=0
 50 LET e=1
 60 PRINT AT 11,12;e;":";d;c;"
";b;a
 70 LET a=a+1
 80 IF a=10 THEN LET b=b+1: LET
a=0
100 IF b=6 AND a=0 THEN LET c=c
+1: LET b=0
110 IF c=10 THEN LET d=d+1: LET
c=0
130 IF d=6 AND c=0 THEN LET e=e
+1: LET d=0
150 IF e=13 THEN LET e=1
155 PAUSE 46.5
160 GO TO 60
```

Spectrum launch in the States

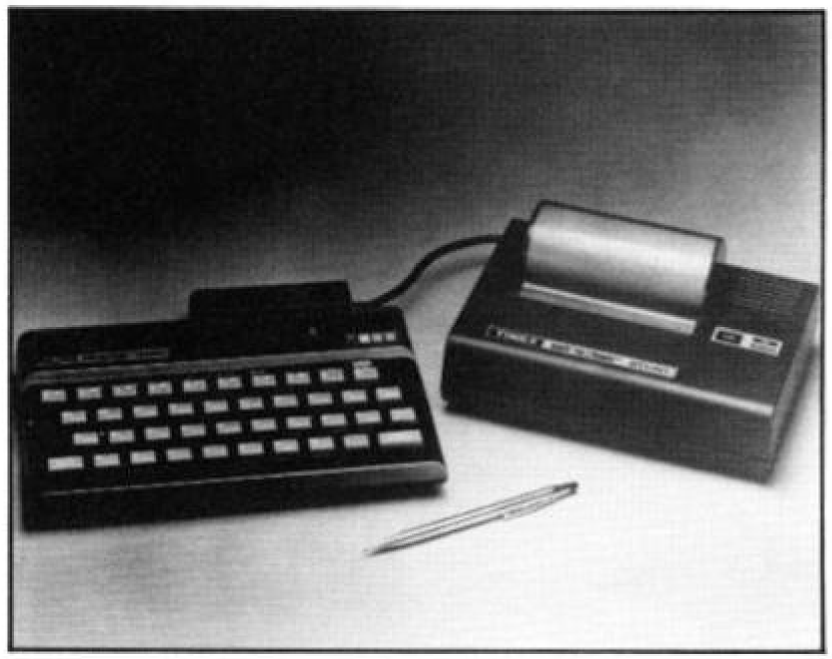
Timex, the company that manufactures the TS1000 (ZX81 to you and me) are soon to launch the American equivalent to the ZX Spectrum.

Designated the TS2000, it is basically an upgrade of the British machine, ie with some of the bugs ironed out! The ROM incorporated in the TS2000 is similar to the one we have all come to know and love, but has been adapted for a number of changes to Sinclair BASIC. For instance, it is reputed that the commands, ATTN, ACS and ASN have been removed, and an AUTO line numbering, a RENUMbering and line deletion function, and other editing features have been inserted to replace them.

Due to the popularity of plug-in cartridges, games or otherwise, in the States, it is thought that the TS2000 will also incorporate a port which will accept 4K — 32K ROM cartridges.

The price of the new machines are to be somewhere in the region of $150 and $200 for the 16K and 48K models respectively. The TS1000 has also been reduced in price recently so that it now compares to the British price for the machine. Incidentally, reports are that the TS1000 has cornered over a quarter of the USA's home computer market.

The TS2000 is also to be launched with the TS2040, a new, larger printer which also utilises a thermal print mechanism.



ROM with a view

For all of you who have trouble coping with the complexities of the Sinclair BASIC manual, there has been set up a programming weekend in the wilds of the Severn Valley.

The computer courses are held at the Gainsborough House Hotel, and can accommodate a maximum of 20 people. The sessions are based on the ZX81 and assume no previous knowledge of computing. Although aimed at people over 16 years of age, children can attend as long as they are accompanied by their parents.

Beginning at 6.45 on the Friday evening, the course runs right the way through to Sunday afternoon. During this period you should be able to squeeze in over 12 hours of hands-on programming. The lecturer, Harry Siddall, has been teaching for 20 years, several of which have been involved in computing science.

Emphasis for the courses is placed on learning through enjoyment, and one look at the hotel's facilities will certainly echo the enjoyment theme. The cost of the course is £55.00, which includes all food, accommodation and VAT. The weekend programming courses are scheduled to run thoroughout April and May.

For more details, contact the Managing Director of Gainsborough House Hotel, Bewdley Hill, Kidderminster, Worcestershire DY11 6BS or 'phone him on 0562 754041.

Shopping for a Spectrum

With sales of the ZX Spectrum now approaching 200,000, Sinclair Research have decided to name a number of new distributors for their computer.

Reports of WH Smiths selling in the region of several thousand devices a week have sponsored Sinclair into nominating Boots, Curry's, Debenhams and their subsidiaries, and John Menzies as main distributors. Smaller retailers such as John Lewis, House of Fraser, Rank Zerox and others will be supplied with Spectrum by Prism Micro Products, Sinclair's own distributors.

This move has obviously been approved to consolidate the Spectrum's position in the home computer market. Said Nigel Searle, Sinclair Research's Managing Director, "We have sold nearly 200,000, mail order and retail, Spectrums in the last nine months, and by Easter expect to be selling 12,000-15,000 Spectrums per week".

Current reports from Sinclair Research suggest tht production figures are in the region of 50,000 Spectrums being manufactured each month and 60,000 ZX81s. This is matched by sales figures for the ZX81 being around 30,000 per month in the UK; this figure is expected to rise over the coming months.

"Overall, we believe we can maintain a 60% volume share of 1983's much enlarged (home computer) market" added Nigel Searle.

For sale

Clive Sinclair has been up to some financial 'wheeler dealing' of late which has made him £13.6 million the richer — possibly allowing him to further his electric car project.

The 400,000 shares (10% of Clive's 95% holding) were sold to large financial institutions at £34 per share.

Last year, Sinclair Research showed a profit of more than £8.8 million on a turnover of £27.62 million. This year (in the year ending on March 31st), it is expected that the company will announce profits of around £14 million.

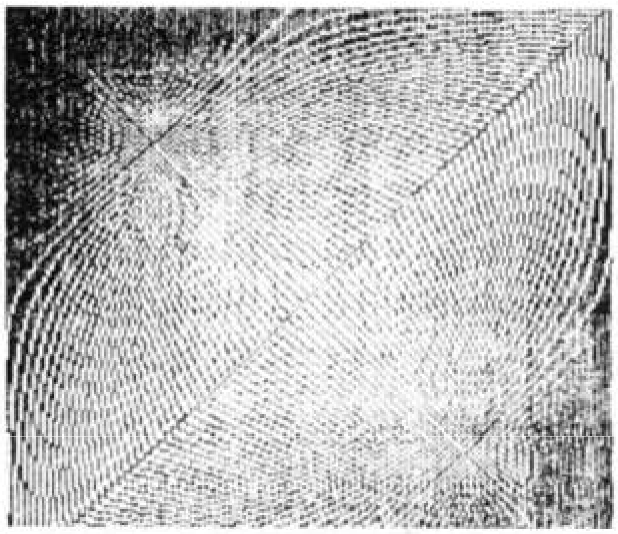
Looking sharp

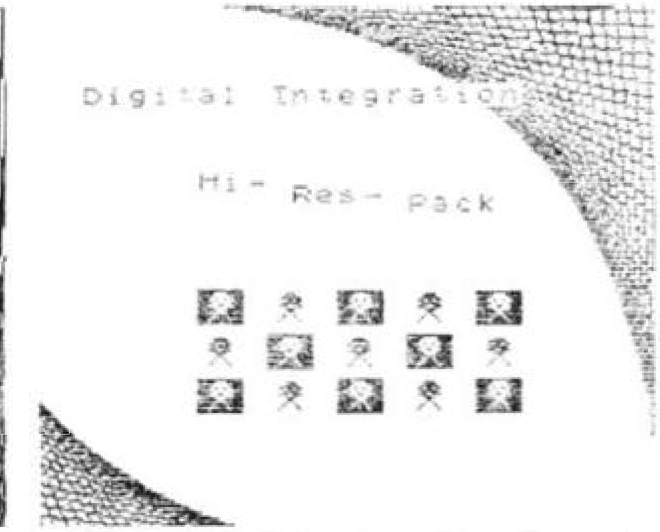
If you're tired of looking at the graphics available on your ZX81, then the new High Resolution Graphics Pack from Digital Integration may be just what you've been looking for.

This new accessory gives your ZX81 a full 256 by 192 pixel display, with full dynamic control of every pixel in BASIC. A 2K EPROM contains the Hi-Res BASIC monitor offering a range of powerful commands, such as PAGE, PLOT and SCROLL, which can be used for defining your own characters (which can be any size and shape), drawing lines, plotting complex functins, and a complete lower case character set for word processing.

The pack is fully compatible with the ZX81 Printer, and comes with a comprehensive handbook illustrating how you can get the most out of the device. The Hi-Res Graphics Pack is housed in a slim case (150mm by 80mm by 22mm) and resides between the RAM Pack and the computer; there is no need for any additional power pack or soldering for operation.

The unit is priced at £38.95, although there is the opportunity for schools to arrange for a discount. For more details get in touch with Digital Integration, 22 Ash Church Road, Ash, Aldershot, Hants GU12 6LX.





Spectrum Upgrades

If you own an Issue 2 Spectrum (which you can easily identify by the large chip in a socket in line with the '9' key, visible in the rear expansion cutout), you may like to know that you can upgrade your 16K memory to 48K for as little as £24.50.

Sounds too good to be true — but that's something you'll have to take up with Fountain Computers Ltd, Darvill Road, Ropley, Alresford, Hants SO24 0BW.

Should you enquire for further details of the 32K upgrade kit, you might also like to to ask about their instructional sheet concerning the display of the ZX Spectrum, both 16K and 48K models.

The A4 sheet, priced at £1.00, provides instructions for optimising the display quality of the Spectrum, simply by adjusting internal controls. Such faults as yellowish whites, the 'Venetian blind' effect and wobbling characters are dealt with, complete with detailed illustrations.

The instructions are very comprehensive and should inspire confidence in even the most nervous user who might want to delve inside their Spectrum. Of course, should you decide to find out more about their upgrade kit and eventually buy one, then they'll give you these display hints free!

Loosing your grip

If you're forever chasing your ZX81 across the table as you type in your latest programming masterpiece, here's a cheap and effective way of pinning the computer down.

The Stabilizer Pad from Stream Computers, although designed for the TS/1000, accommodates the ZX81 perfectly. Made of a strong rubbery substance, the Stabilizer Pad eliminates sliding and movement and, by holding the RAM Pack securely, also prevents program loss. The computer is also held in a forward position making typing much easier.

Its manufacturers are currently trying to find a UK distributor, but until they do you can still order one direct from Stream Computers. Priced at £4.50 (which includes first class postage), the round trip of order and shipment takes approximately five weeks.

Further information is obtainable from Stream Computers, PO Box 113, Ajax, Ontario L1S 3C5, Canada.



Between the lines

A parallel Centronics interface, ZX LPRINT, is now available for use with the ZX Spectrum.

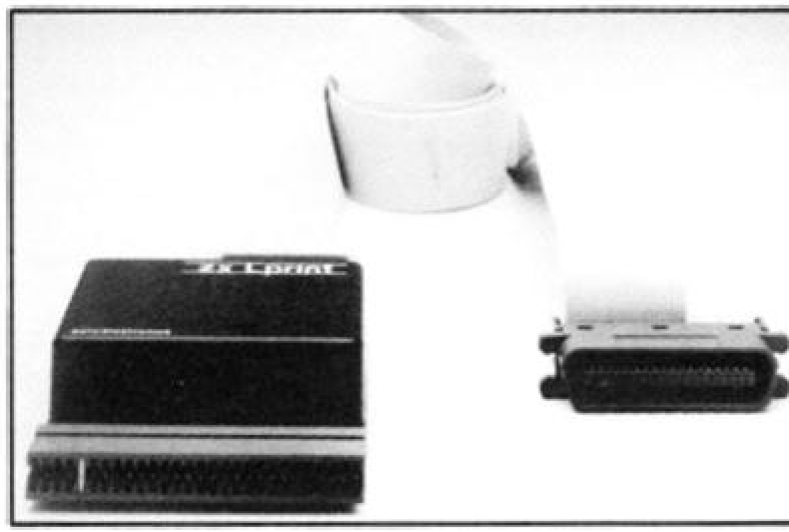
Plugging directly into the rear connector of the Spectrum, the ZX LPRINT translates LPRINT and LLIST output into parallel Centronics format. This means that any number of characters (within the capabilities of the printer used) can be printed to the standards of professional word processing.

The unit itself, measuring 70mm by 65mm by 25mm, can convert the output to produce Sinclair tokens, ie SCREEN$, RANDOMIZE, etc. Printers which require special control characters from the range 128 to 255 to access some of their functions can also be used with this new interface; commands are used to switch off the Sinclair character set at times when you wish to utilise the capabilities of the printer's full character set.

A COPY command will dump the complete screen to a high resolution graphics printer; COPY software to go with the interface is supplied on a separate cassette. (LPRINT and LLIST commands do not need extra software, all that is needed is the interface plugged into the computer.)

Priced at around £30.00, you can find out further information on this product from Euroelectronics, Zlin House, Oakfield Street, Cheltenham, Glos GL50 2UJ.





On your desk

A desk console has been announced from TTL which will hold everything you should need to make the most of your Spectrum.

Constructed from strong ABS plastic, the unit has a detachable base cover and non-slip feet. The console weighs 1.5kg and measures 555mm by 370mm by 50mm.

Provision is made for the unit to accommodate a power supply, a Sinclair Printer, an RS232 interface, joystick control, two Microdrives, a cassette recorder and a selection of cassettes, pencils, etc. There is a switch panel with a three-position slide switch for SAVE/RUN — LIST/LOAD VERIFY (earthing unused inputs to cassette recorder and computer). A switch for the 9V power supply ON/OFF, LED indicator for the PSU are also included in the device. Optional extras such as stacking pillars and a soft PVC dust cover are also available from TTL.

The desk console is priced at £42.18 and is available from Traffic Technology Ltd, PO Box 2, Warminster, Wiltshire BA12 7QX.



Off the shelf

Quicksilva have released a new range of games for the ZX81 and ZX Spectrum.

Six new packages are available for the 16K ZX81, three of which are Quicksilva original games. The first is called Croaka Crawla and is a version of the famous frog hopping game with special features such as flies, crocodiles, sinking turtles, logs and progressively difficult attack waves.

The second new game is called Muchees and (yes, you've guessed it) it is a version of the pill-eating game featuring ghosts, power pills, side doors, fruit and, of course, the lovable munchees. The third package is called Galaxians, but also includes a game called Gloops. The main program on this cassette, Galaxians, is an implementation of the classic arcade game, with two different types of Galaxian. However, perhaps the best part of this game is that you are able to tailor the game to suit your own particular tastes in terms of speed, firing rate and the number of Galaxians. (Now you need not spend your first 30 games of Galaxian trying to beat 10 points!)

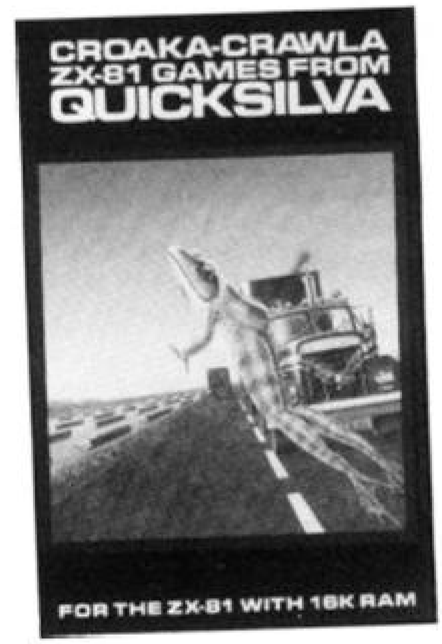
Croaka Crawla, Munchees, and Galaxians are priced at £3.95, £3.95 and £4.95 respectively.

Quicksilva have also taken over the marketing of the range of Pixel games for the 16K ZX81. Now re-packaged with new covers, the titles have been doubled up or added to so that they fit in with Quicksilva's pricing structure.

Among the new Quicksilva (née Pixel) software is Trader, which is now supplied in a box with a comprehensive booklet describing the background to the game and an original Trader story from Mark Eyles; Sub-Space Striker and Zor; and Star-Quest and Encounter. Trader, Sub-Space Striker and Zor, and Star-Quest and Encounter are priced at £9.95, £3.95 and £3.95 respectively.

For the 48K Spectrum comes a new game called Mined-Out. With not an alien in sight, Mined-Out features nine levels of minefield to struggle across, with various damsels in distress to worry over and other weird and wonderful things, such as Bill the Worm, Tricky Mine, Bugs and the Mine Spreaders. Mined-Out is available at the price of £4.95.

On a more serious note, under the proud boast 'Now the sun never sets on Quicksilva', it seems they have established distributors throughout most of the world (and the bits they haven't yet tied up should be so in the near future, so they assure me). So, if you're reading this in a foreign clime and fancy getting your 'gaming fingers' around the latest Quicksilva software, write to them at 92 Northam Road, Southampton SO2 0PB. Telephone enquiries can be made on 0703 20169.









Good health

A series of six cassettes designed to educate and advise on a comprehensive range of medical topics is now available for the 16K ZX81.

The six cassettes cover the following range of subjects: Basic Medicine, Mainly for Women, Mainly for Men, All About Children, How Healthy Are You? – A Home Screening Program, and 101 Home Nursing Tips. Each cassette contains an average of 18 individual programs, each packed with advice and information listed by sympton or health topic. According to how the user responds to each question, various advice is given as to possible diagnosis, the urgency with which the user should seek medical help and, where appropriate, the form of home treatment to be employed.



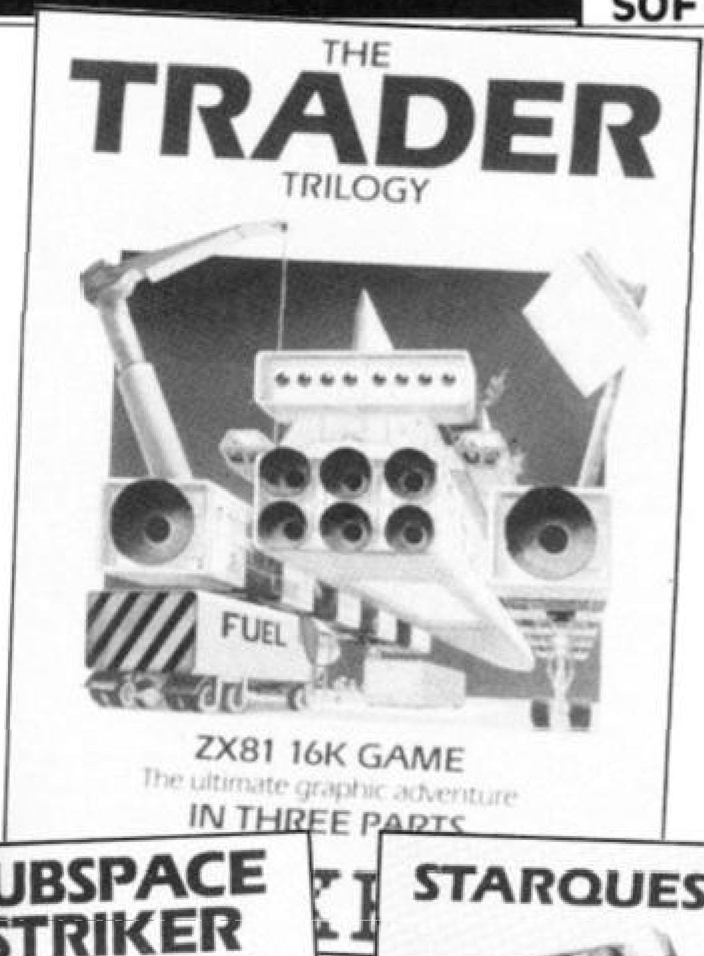
LISPing on your Spectrum

An interpreter for the artificial intelligence research language, LISP, is now available for the ZX Spectrum. Suitable for students learning LISP, the package should also be of interest to hobbyists eager to learn an alternative language to BASIC and gain an insight into artificial intelligence.

The LISP interpreter features over 50 pre-defined functions; it allows iteration via PROGN and WHILE functions; incorporates LOAD, SAVE and VERIFY functions as well as an LPRINT function to output to the printer. The interpreter also allows a variable number of parameters to user-defined functions; supports machine code subroutines; incorporates 16-bit signed integer arithmetic; has full error checking, compacting garbage collector and full property list implementation.

The LISP package includes a 4.5K machine code interpreter and a 2.6K initialised property list. Ideally requiring 48K of memory, the program will run in 16K.

Complete with a demonstration program and a programmer's manual, the LISP interpreter is priced at £15.00. To learn more about the interpreter, send for details from Serious Software, 7 Woodside Road, Bickley, Bromley, Kent BR1 2ES.







A grand program

Holdco have announced an adventure-game package called The Secret of Tamworth Manor in which you get the chance to win £1,000.

The story so far is that William Tamworth buried the Tamworth fortune somewhere near Tamworth Manor during the English Civil War. After Tamworth Manor was razed to the ground and William met with a particularly horrible death, only Charles Tamworth, an elderly descendent, suspects that the money is still in its original burial place. So, after much research into the family archives, he solves the secret and as he has no need of the money (?) decides to leave it to whoever can solve the two riddles he has left.

The first part of the cassette adventure is available now, and the second part of the puzzle will be sent out to all those who have the first part after May 31, 1983. Designed to operate on the 16K ZX81, Holdco claim that the first cassette of clues will be more than enough to keep you busy until May.

Somewhere in your travels to solve the puzzle (yes, you do actually have to get out of doors for this one) you may find a number of clues or unexpected help to aid you in your quest.

It's no use asking Holdco for any information about the money (all they'll tell you is that the treasure is buried somewhere in the Home Counties) but they will certainly be happy to tell you more about the package.

So, for more details on The Secret of Tamworth Manor, contact Holdco Ltd, 14 Britton Street, London EC1M 5NQ or 'phone 01-251 3090. The price of the package is £14.95.

The 'X' factor

A new software package is now available from C.C.S. for the 16K ZX81 and Spectrum called Modeller X.

Modeller X is a user friendly financial modeller program which could prove a valuable assett to a small business concern. The program is menu driven and allows the user to assess the sensitivity of changes in the market forces to the effectiveness of salespeople and advertising in relation to the elasticity of demand and pricing policy. Thus, the user is able to optimise the decisions to be made concerning the business.

Priced at £8.00, further information can be obtained from C.C.S., 14 Langton Way, London SE3 7TL. You could also ask about the new range of financial modellers currently being developed which are planned to assist in estimating cash flow, credit control and the more detailed aspects of marketing and production.

For the under 8's

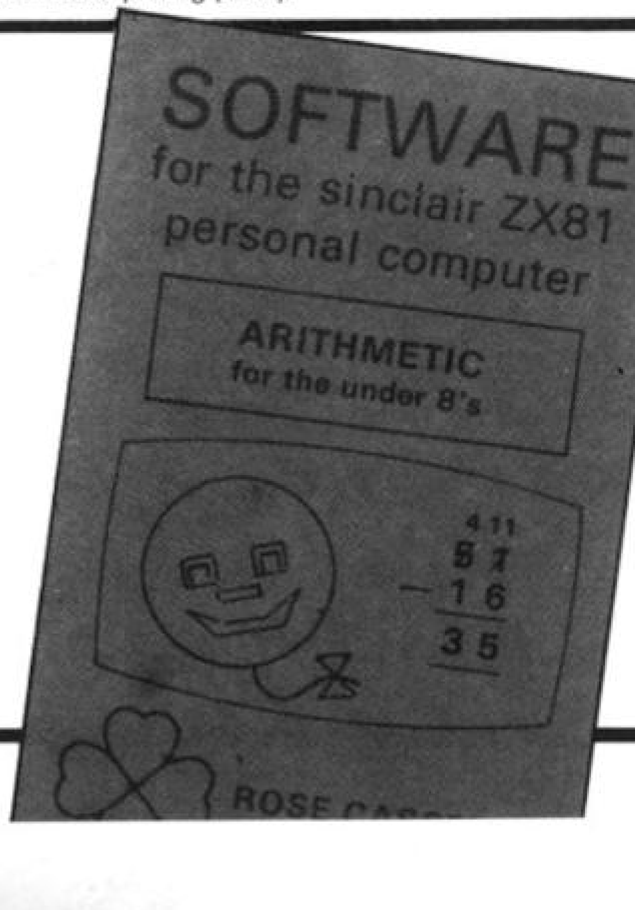
Rose Cassettes have released a new cassette aimed at teaching the basics of arithmetic to the under 8's.

Called Arithmetic for the under 8's, the program is designed to be run on a 16K ZX81. The package comprises four programs: Add, Subtract, Multiply and Divide. Each program (except Divide) allows for the entry of units in a strict order, all numbers being printed in a large size so that children can easily recognise them.

Each program has three levels of difficulty: units only, tens and units, and hundreds, tens and units. Obviously, as the child becomes more confident with numbers, you can progress through these levels. Appropriate questions throughout the program are asked, such as 'Do you need to borrow one?' and 'What shall I bring forward?', to aid the user in decisions.

For each sum correctly answered, the features of a balloon face are built up; in much the same way, if a sum is incorrectly answered a feature of the balloon's face is erased. When all the features of the face are complete, the balloon takes off (with the help of a machine code routine or two!).

The maths package is priced at £4.50. For more details of this and the rest of their large range of educational software, get in touch with Rose Cassettes, 148 Widney Lane, Solihull, West Midlands B91 3LH.



Club corner



If you run, or are a member of, a user club which caters for the Sinclair user, why not get your group on the map by writing to us at:

Club Corner,
ZX Computing,
145 Charing Cross Road,
London WC2H 0EE.

All you have to do is to send us a letter with details of your club (times of meetings, addresses of who to contact, etc) and we'll do the rest. If you publish a newsletter or club magazine, we'd very much like to see that too.

And if you don't see a club in your area, why not start one up by writing to ZX Computing and seeing if any like-minded enthusiasts wish to join you.

Belgian National Sinclair Club

Dear ZX Computing,
From January 1, 1983, the Sinclair Club of Belgium becomes a national club.

Thanks to the help of some handicapped members, we are able to publish a multi-language club magazine. Indeed, in Belgium, it is difficult to find a job unless you have a working knowledge of Flemish, French, English and, if possible, German. So, members of our club not only learn all about the Sinclair computers, but are also motivated to learn foreign languages!

The club is very much a non-profit organisation, with positive social aims. For the record, the correct title for the club is: ASBL 'B.D.M.A.' VZW, The Belgian National Sinclair Club.

Should any of your readers require further information, they may contact me at the address given below.
Yours faithfully,

P Glenisson,
Chairman,
Rue Abbe De L'Epeestraat, 14,
1200 Brussels,
Belgium.

Aylesbury ZX Computer Club

Dear ZX Computing,
I have enclosed the latest issue of our club magazine, and am writing to remind your readers who live in our local area that they would be more than welcome at our club.

We have weekly meetings at Quarrendon School every Friday at 7.30pm, and we also have a monthly meeting on the first Wednesday of each month at 7.30pm at Aylesbury College. For further details of these meetings, you could always 'phone me on Aylesbury 630867.

The club membership fee is £5.00 per annum, and each member receives a copy of our monthly newsletter.
Yours faithfully,

David Nowotnik,
Aylesbury ZX Computer Club.

Swansea Computer Club

Dear ZX Computing,
The Swansea Computer Club has now been in existance for about six months and considering how young the club is, we have had a very encouraging response. (Perhaps you saw our stand at the January Microshow in Swansea.)

An aim of the club is to organise lessons for beginners in BASIC, and we hope to start this course in the near future. Anybody with an interest in computing will be welcomed to our club, although you do not have to own your own micro to be a memeber.

The Swansea Computer Club meets every Tuesday night from 6.00pm at the Three Lamps, top floor, Castle Square, Swansea. For further details of the club's activities, you can write to me at the address given below or 'phone me on Swansea 203811.
Yours faithfully,

SC Morris,
Acting Secretary,
9 Yr Gorlan,
Killay,
Swansea.

Lambeth Computer Club

Dear ZX Computing,
Our club is being formed from the local inhabitants of Lambeth. Its aim is to promote the use of computers in Lambeth by the home, school or business user. Within this scope, all kinds of people are welcome — whether you want to play games, write educational software, or simply indulge an interest in the subject.

The initial plan is to see if there is sufficient interest (I have every confidence that there will be!) to take the idea forward. If there is the response, an inaugral meeting will be arranged, and we will hopefully get ourselves affiliated to the Association of London Computer Clubs.

So, if anyone is interested in helping to get the club together, contact me at the address given below.
Yours faithfully,

Robert Baker,
54 Brixton Road,
London SW9 6BS.



The club magazines of the Aylesbury ZX Computer Club and the Belgian National Sinclair Club.

ANDREW HEWSON'S BOOKS FOR THE SPECTRUM



Mr HELPLINE – the man who answers your ZX queries in his column in Sindair User, the author of HINTS & TIPS FOR THE ZX80 and HINTS & TIPS FOR THE ZX81 now presents:

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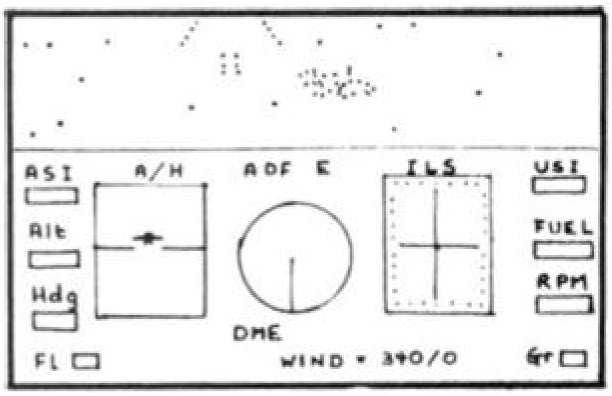
Section B: 40 routines including,

- Scroll – up, down, side to side by pixel or by character.
- Search and replace, token swap, string search.
- Rotate character, invert character – horizontally and vertically.
- Line remember – including GOSUBs, GOTOs, RUN etc.

All routines are relocatable (except 'line remember')

This book teaches the beginner all he needs to know in a simple, easy-to-learn form and its an invaluable reference work for the expert too!

NIGHTFLITE FOR ZX SPECTRUM £5.95



Fly your own aircraft from take off to landing via navigational beacons, over mountains and using a fully detailed direction finding and instrument landing system. *You are the Pilot of a light aircraft flying at night. *You must use your skill and judgment to fly your aircraft accurately over radio beacons and then land safely on the runway *Hazards are mountains and cross winds *Instruments: Artificial Horizon, Non Directional Beacon, VHF Omnidirectional Range, Instrument Landing System *Readouts: Gear, Flap, Air Speed, Distance Measuring Equipment, Vertical Speed, RPM and heading *Visual display of runway on approach *5 Modes from Take off to Autopilot *Happy landings.*

Z80 OP CODES £1.45

A must for the beginner and the experienced programmer alike. This hand ready reckoner lists all 600 plus Z80 machine code instructions in decimal and hexadecimal with their mnemonics. Each Op Code is succinctly explained and cross-referenced. Supplied in a protective transparent wallet for easy reference and durability.

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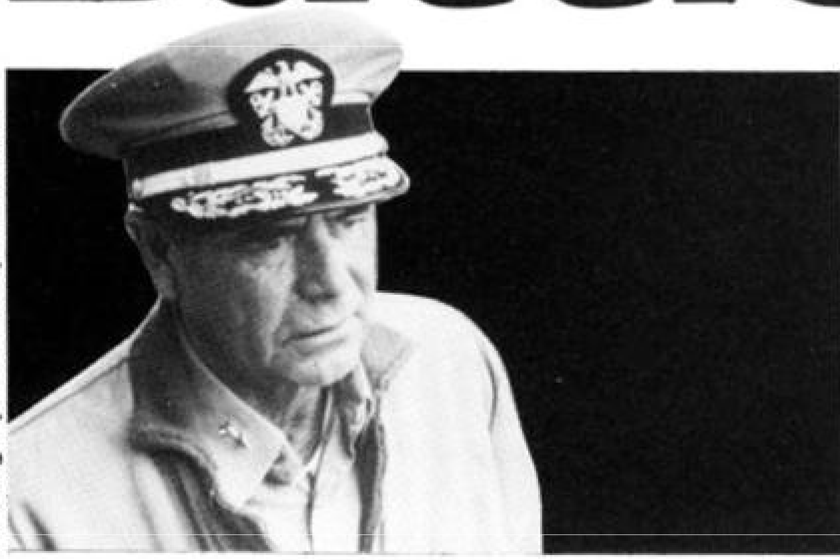
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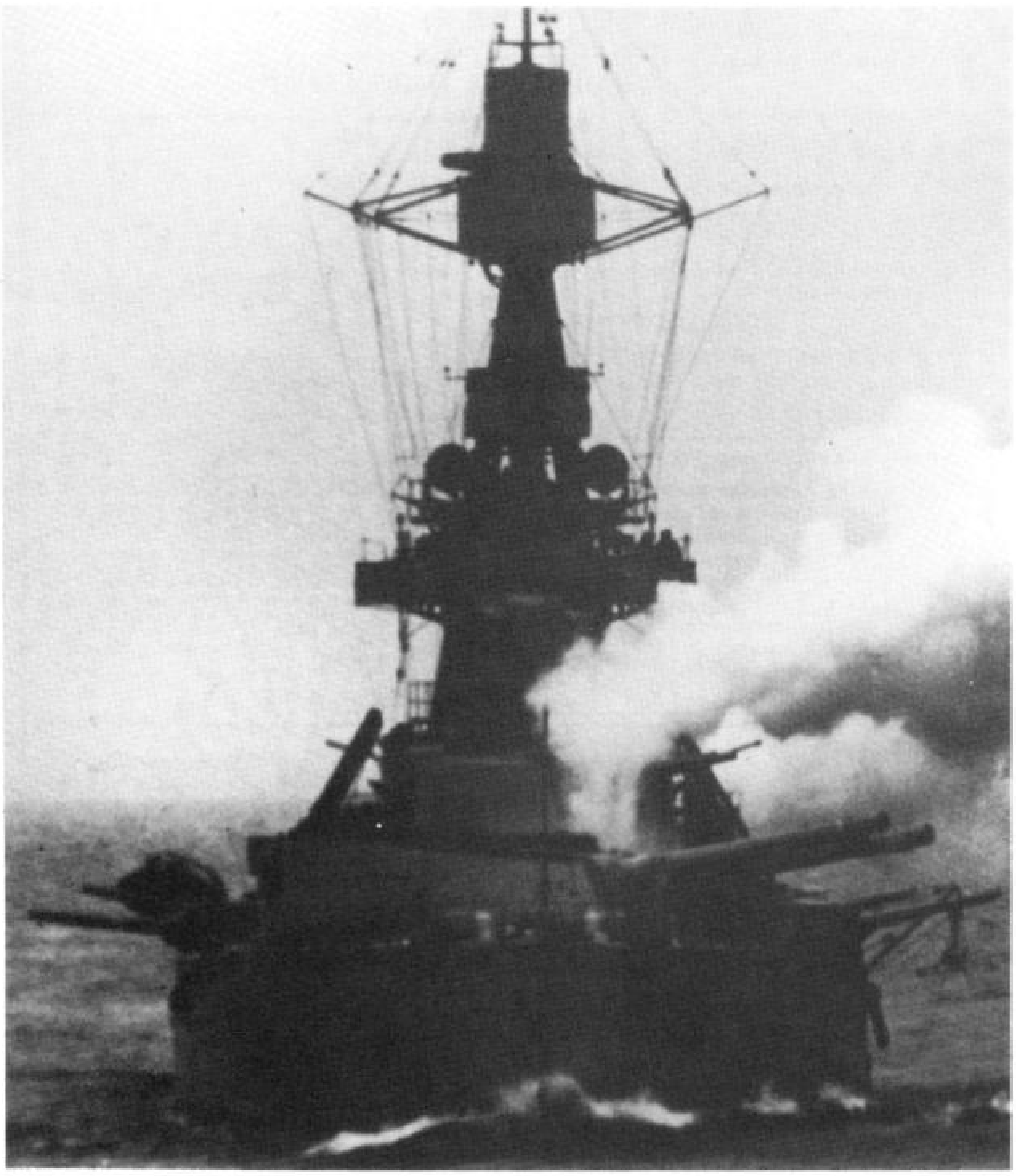
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Battleships



Photograph courtesy of CIC Ltd.

Command your own fleet with this program by Jeff Hamilton of Gillingham.



Photograph of HMS Ajax courtesy of the Royal Navy.

This program has been written to allow users to challenge their Spectrum computer to the age-old classroom game of Battleships.

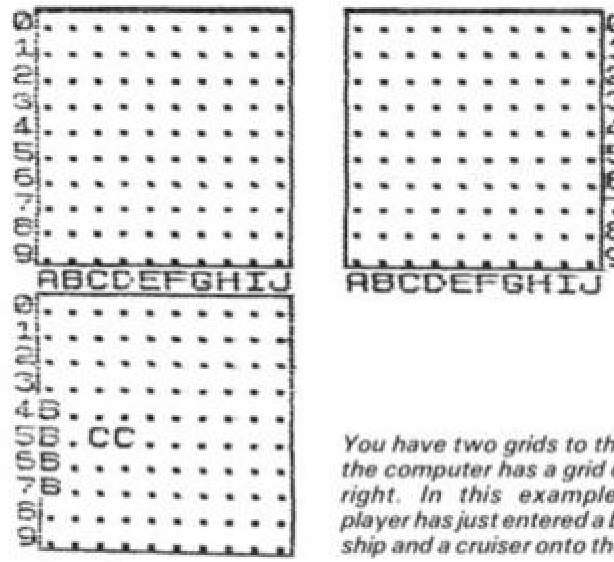
When you have the game RUNning, you will be asked to INPUT the direction of your ships and the starting square. The Spectrum will automatically set your ships on the grid. Once, a battleship (four squares), two cruisers (three squares) and three destroyers (two squares) have been set up, the Spectrum decides who should begin the game.

The Spectrum's moves are calculated in lines 1000 to 1080; a random square is chosen to fire at unless the Spectrum has just scored a hit on your fleet. If it has just achieved damage to one of your ships, it will continue to fire at the surrounding squares until it has sunk the vessel.

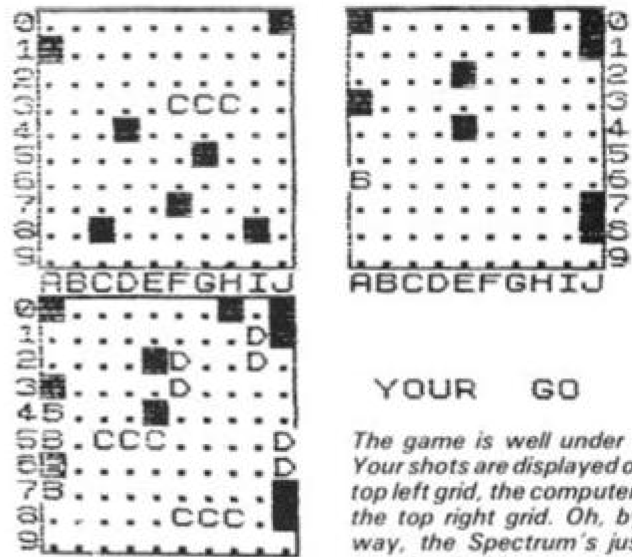
In the navy

Once the Spectrum has selected a square to fire at, it is up to the user to respond with either a 'M' for a miss or an 'H' for a direct hit. There is no routine in the program to counteract the user lying to the computer, but there is no reason why a simple routine could not be written to stop any 'innocent' cheating.

When it is the user's turn, simply INPUT the co-ordinates, for example, 'F7' for the grid reference F7, and the result will be displayed on the screen as a miss or as a hit with accompanying BEEP. It might be an idea to make a mental note as to which squares you have already fired at, as the computer will not tell you if you have already had a go at a certain grid reference.



You have two grids to the left, the computer has a grid on the right. In this example, the player has just entered a battleship and a cruiser onto the grid.



The game is well under way! Your shots are displayed on the top left grid, the computer's on the top right grid. Oh, by the way, the Spectrum's just hit your battleship . . .



Photograph of HMS Ajax courtesy of the Royal Navy.

```
50 GO SUB 6000: REM ** RULES **
100 GO SUB 5000: REM ** INITIALISE VARIABLES **
110 CLS : GO SUB 5300: REM ** SET UP BOARD **
120 GO SUB 6500: REM ** SET UP 3RD SQUARE **
130 GO SUB 5400: REM ** HIDE SHIPS **
135 LET Z=INT (RND*2): IF Z=1 THEN GO TO 150
140 GO TO 700: REM ** PLAYER GO **
150 GO TO 1000: REM ** SPECTRUM GO **
700 PRINT AT 14,14; PAPER 1; INK 7;"YOUR  GO"
710 INPUT D$: IF LEN D$<>2 THEN GO TO 710
715 LET B$=D$(1): LET C=VAL D$(2)
720 LET D=CODE B$-64
725 IF (C<0 OR C>9) OR (D<1 OR D>10) THEN GO TO 710
730 LET W=D: LET N=C+1
740 LET J=M(N,W)
750 IF M(N,W)<>143 THEN LET HITS=HITS+1
770 PRINT INK 2;AT C,D;CHR$ J: IF J>100 THEN LET J=J-100
775 BEEP .05,J-40
780 IF HITS=16 THEN GO TO 4000
790 GO TO 150
1000 IF LB=0 AND LC=0 AND LD=0 THEN GO SUB 1500
```

```
1010 IF LB=1 OR LC=1 OR LD=1 THE
N GO SUB 1800
1020 IF LB>1 OR LC>1 THEN GO SUB
 2000
1030 INPUT M$: IF NOT M$="H" AND
 NOT M$="M" THEN GO TO 1030
1040 IF M$="M" THEN GO SUB 1550
1050 IF M$="H" THEN GO SUB 1580
1060 PRINT INK 2;AT X-4,Y+9;CHR$
 J: IF J>100 THEN LET JJ=J-100
1061 IF J<100 THEN LET JJ=J
1062 PRINT ; INVERSE 1; INK 1; F
LASH 0;AT X+7,Y-3;CHR$ J
1063 IF J>100 THEN PRINT ; INVER
SE 0; INK 1; FLASH 0;AT X+7,Y-3;
CHR$ J
1064 BEEP .05,JJ-40
1065 LET L(X,Y)=J
1070 IF HATS=16 THEN GO TO 4020
1080 GO TO 140
1500 LET X=INT (RND*10)+4: LET Y
=INT (RND*10)+4
1510 IF L(X,Y)<>46 THEN GO TO 15
00
1515 IF L(X+1,Y)<>46 AND L(X,Y-1
)<>46 AND L(X-1,Y)<>46 AND L(X,Y
+1)<>46 THEN GO TO 1500
1520 LET YA=Y+61
1530 PRINT AT 14,14; PAPER 2; IN
K 7;"MY GO ";CHR$ YA;X-4
1535 PRINT ; BRIGHT 1; INK 1; FL
ASH 1;AT X+7,Y-3;"?"
1540 RETURN
1550 LET J=143
1560 IF LB=1 OR LC=1 OR LD=1 THE
N LET LZ=LZ+1
1570 RETURN
1580 PRINT AT 16,14; PAPER 4; IN
K 7;"B,C OR D?"
1590 INPUT N$: FOR N=1 TO 9: PRI
NT AT 16,N+13; PAPER 7; INK 7;CH
R$ 32;: NEXT N
1600 LET HATS=HATS+1
1610 IF N$="B" THEN GO SUB 1750
1620 IF N$="C" THEN GO SUB 1700
1630 IF N$="D" THEN GO SUB 1650
1640 RETURN
1650 LET J=CODE "D"
1660 LET LD=LD+1
1670 IF LD=2 THEN LET LZ=0
1680 IF LD=2 THEN LET LD=0
1690 RETURN
1700 LET J=CODE "C"
1710 LET LC=LC+1
1720 IF LC=3 THEN LET LZ=0: LET
LY=0
1730 IF LC=3 THEN LET LC=0
1740 RETURN
1750 LET J=CODE "B"
1760 LET LB=LB+1
1770 IF LB=4 THEN LET LZ=0: LET
LY=0: LET LR=0
1780 IF LB=4 THEN LET LB=0
1790 RETURN
1800 IF (LB=1 OR LC=1) AND LZ=0
THEN IF (L(X-2,Y)<>46 AND L(X+1,
Y)<>46) OR (L(X-1,Y)<>46 AND L(X
+2,Y)<>46) THEN LET Y=Y-1: LET L
Z=2: GO TO 1970
1810 IF (LB=1 OR LC=1) AND LZ=1
THEN IF L(X+3,Y)<>46 THEN LET X=
X+1: LET Y=Y-1: LET LZ=2: GO TO
1970
1850 IF LZ=0 THEN GO TO 1890
1860 IF LZ=1 THEN GO TO 1930
1870 IF LZ=2 THEN GO TO 1965
1880 IF LZ=3 THEN GO TO 1985
1890 LET X=X-1
1900 IF L(X,Y)<>46 THEN GO TO 19
20
1910 LET LZD=1: GO TO 1990
1920 LET LZ=LZ+1
1930 LET X=X+2
1940 IF L(X,Y)<>46 THEN GO TO 19
60
1950 LET LZD=2: GO TO 1990
1960 LET LZ=LZ+1
1965 LET X=X-1: LET Y=Y-1
1970 IF L(X,Y)<>46 THEN GO TO 19
80
1975 LET LZD=3: GO TO 1990
1980 LET LZ=LZ+1
1985 LET Y=Y+2: LET LZD=4
1990 GO SUB 1520
1995 RETURN
2000 IF LZD=1 THEN GO SUB 2050
2010 IF LZD=2 THEN LET X=X+1
2020 IF LZD=3 THEN GO SUB 2080
2030 IF LZD=4 THEN LET Y=Y+1
2040 GO SUB 1520: RETURN
2050 IF LB=2 OR LC=2 THEN GO SUB
 2110
2060 IF LB=3 THEN GO SUB 2300
2070 RETURN
2080 IF LB=2 OR LC=2 THEN GO SUB
 2160
2090 IF LB=3 THEN GO TO 2400
2100 RETURN
2110 IF (LB=2 OR LC=2) AND LY=1
THEN LET X=X+3: RETURN
2120 LET X=X-1
2130 IF X=3 THEN GO TO 2150
2140 IF L(X,Y)=46 THEN LET LY=LY
+1: RETURN
2150 IF LB=2 OR LC=2 THEN LET X=
X+3: RETURN
2160 IF (LB=2 OR LC=2) AND LY=1
THEN LET Y=Y+3: RETURN
2170 LET Y=Y-1
2180 IF Y=3 THEN GO TO 2200
2190 IF L(X,Y)=46 THEN LET LY=LY
+1: RETURN
2200 IF LB=2 OR LC=2 THEN LET Y=
Y+3: RETURN
2300 IF LR=1 THEN LET X=X+4: RET
URN
2310 LET X=X-1
2320 IF X=3 THEN LET X=X+4: RETU
RN
2330 IF L(X,Y)<>46 THEN LET X=X+
2: RETURN
2340 IF L(X,Y)=46 THEN LET LR=1:
 RETURN
2400 IF LR=1 THEN LET Y=Y+4: RET
URN
2410 LET Y=Y-1
2420 IF Y=3 THEN LET Y=Y+4: RETU
RN
2430 IF L(X,Y)<>46 THEN LET Y=Y+
2: RETURN
2440 IF L(X,Y)=46 THEN LET LR=1:
 RETURN
4000 PRINT AT 16,14;"YOU WON": G
O TO 4040
4020 PRINT AT 16,14;" I WON ": G
O TO 4040
4040 PRINT AT 18,14;"AGAIN? (Y/N
)"
4050 INPUT Y$
4055 IF NOT Y$="Y" THEN GO TO 40
70
4060 IF Y$="Y" THEN RUN
4070 PRINT AT 21,14;"OK BYE": GO
 TO 9000
5000 REM ** INITIALISE **
5010 POKE 23609,100
5020 DIM L(16,16)
5025 DIM M(10,10)
5027 FOR N=1 TO 10: FOR W=1 TO 1
0
5028 LET M(N,W)=143
5030 NEXT W: NEXT N
5035 RANDOMIZE
5040 LET HITS=0: LET HATS=0
5050 LET LB=0: LET LC=0: LET LD=
0: LET LZ=0: LET LA=0: LET LZD=0
5070 LET LX=0: LET LY=0: LET XX=
0: LET LR=0
5080 FOR X=1 TO 3: FOR Y=1 TO 3
```

```
5090 LET L(X,Y)=100: NEXT Y: NEXT X
5100 FOR X=4 TO 13: FOR Y=4 TO 13
5110 LET L(X,Y)=46: NEXT Y: NEXT X
5120 FOR X=14 TO 16: FOR Y=14 TO 16
5130 LET L(X,Y)=100: NEXT Y: NEXT X: RETURN
5300 REM ** SET UP BOARD **
5310 FOR A=0 TO 9
5320 PRINT INK 1;A; PAPER 6; INK 2;".........."; PAPER 7;"  "; PAPER 6;".........."; INK 1; PAPER 7;A
5330 NEXT A
5340 PRINT INK 1;" ABCDEFGHIJ   ABCDEFGHIJ "
5350 FOR A=0 TO 9
5360 PRINT INK 1;A; PAPER 6; INK 2;"..........": NEXT A
5370 PLOT 8,8: GO SUB 5395
5380 PLOT 8,96: GO SUB 5395
5390 PLOT 104,96: GO SUB 5395: RETURN
5395 DRAW INK 2;79,0: DRAW INK 2;0,79: DRAW INK 2;-79,0: DRAW INK 2;0,-79: RETURN
5400 REM ** HIDE SHIPS **
5410 LET AB=6: GO SUB 5600: FOR P=1 TO 4
5420 LET M(N,W)=CODE "B"
5430 GO SUB 5640: NEXT P
5440 FOR E=1 TO 2
5450 LET AB=7: GO SUB 5600: GO SUB 5670: IF A=1 THEN GO TO 5450
5460 FOR P=1 TO 3
5470 LET M(N,W)=CODE "C"
5480 GO SUB 5640: NEXT P: NEXT E
5490 FOR E=1 TO 3
5500 LET AB=8: GO SUB 5600: GO SUB 5700: IF A=1 THEN GO TO 5500
5510 FOR P=1 TO 2
5520 LET M(N,W)=CODE "D"
5530 GO SUB 5640: NEXT P: NEXT E
5540 RETURN
5600 LET A=0: LET AA=INT (RND*2)
5610 IF AA=0 THEN LET N=INT (RND*AB)+1: LET W=INT (RND*10)+1
5620 IF AA=1 THEN LET N=INT (RND*10)+1: LET W=INT (RND*AB)+1
5630 RETURN
5640 IF AA=0 THEN LET N=N+1
5650 IF AA=1 THEN LET W=W+1
5660 RETURN
5670 IF AA=0 THEN IF M(N,W)<>143 OR M(N+1,W)<>143 OR M(N+2,W)<>143 THEN LET A=1
5680 IF AA=1 THEN IF M(N,W)<>143 OR M(N,W+1)<>143 OR M(N,W+2)<>143 THEN LET A=1
5700 IF AA=0 THEN IF M(N,W)<>143 OR M(N+1,W)<>143 THEN LET A=1
5710 IF AA=1 THEN IF M(N,W)<>143 OR M(N,W+1)<>143 THEN LET A=1
5720 RETURN
6000 FOR Y=1 TO 7: BORDER Y: FOR N=1 TO 4: BEEP .005,N+Y
6100 PRINT ; PAPER N; INK N+2;AT 2,5;""
6110 PRINT ; PAPER N; INK N+2;AT 3,5;""
6120 PRINT ; PAPER N; INK N+2;AT 4,5;""
6130 PRINT ; PAPER N; INK N+2;AT 5,5;""
6140 PRINT ; PAPER N; INK N+2;AT 6,5;""
6150 PRINT ; PAPER N; INK N+2;AT 8,8;""
6160 PRINT ; PAPER N; INK N+2;AT 9,8;""
6170 PRINT ; PAPER N; INK N+2;AT 10,8;""
6180 PRINT ; PAPER N; INK N+2;AT 11,8;""
6190 PRINT ; PAPER N; INK N+2;AT 12,8;""
6195 PRINT ; PAPER N+1; INK N+3;AT 14,4;
6200 NEXT N: NEXT Y
6210 PAUSE 60
6220 PRINT ; PAPER 1; INK 7; FLASH 1;AT 16,0;"ALWAYS ENTER LETTER AND NUMBER      THEN PRESS ENTER      "
6230 PAUSE 60: GO SUB 6400
6240 PAUSE 4E4: GO SUB 6410
6250 PRINT ; PAPER 3; INK 6; FLASH 0;AT 16,0;"  FIRST SET UP 3RD SQUARE   BY INPUTTING ONE BATTLESHIP  (4 SQUARES) TWO CRUISERS (3 SQS) AND THREE DESTROYERS (2 SQS)  "
6260 PAUSE 60: GO SUB 6400
6270 PAUSE 4E4: GO SUB 6410
6280 PRINT ; PAPER 1; INK 7;AT 16,0;" WHEN IT IS YOUR GO (TOP LEFT)        INPUT YOUR GUESS      ON THE SPECTRUMS GO (TOP RIGHT) INPUT-M-IF MISS;-H-IF HIT: IF HIT  YOU WILL BE ASKED WHICH SHIP "
6290 PAUSE 60: GO SUB 6400
6300 PAUSE 4E4: GO SUB 6410: RETURN
6400 PRINT ; FLASH 1;AT 21,8;"PRESS ENTER": RETURN
6410 PRINT FLASH 0;AT 21,8;"           ": RETURN
6500 REM ** SET UP 3RD SQUARE **
6510 LET X$="BATTLESHIP (4)"
6520 LET DF=6: LET J=66
6530 LET X=4: GO SUB 6700
6540 LET X$="CRUISER (3)"
6550 LET DF=7: LET J=67: LET X=3
6560 GO SUB 6700: GO SUB 6700
6570 LET X$="DESTROYER (2)"
6580 LET DF=8: LET J=68: LET X=2
6590 GO SUB 6700: GO SUB 6700: GO SUB 6700: RETURN
6600 PRINT AT 14,17;"     ";AT 15,15;"       ";AT 16,15;"       ";AT 17,18;"    ";AT 18,13;"       "
6610 RETURN
6630 IF BR=1 THEN LET C=C+1
6640 IF BR=2 THEN LET D=D+1
6650 RETURN
6700 PRINT AT 14,17; INK 3;"INPUT";AT 15,15;"1 FOR N/S";AT 16,15;"2 FOR E/W"
6710 INPUT BR: IF BR<1 OR BR>2 THEN GO TO 6710
6720 IF BR=1 THEN LET DD=DF: LET DE=9
6730 IF BR=2 THEN LET DD=9: LET DE=DF
6740 PRINT AT 14,17; INK 4;"ENTER";AT 15,15;"STARTING ";AT 16,15;" SQUARE  ";AT 17,18;"FOR";AT 18,13;X$
6750 INPUT A$: IF LEN A$<>2 THEN GO TO 6750
6760 LET B$=A$(1): LET C=VAL A$(2)
6770 LET D=CODE B$-65
6780 IF C<0 OR C>DD THEN GO TO 6750
6790 IF D<0 OR D>DE THEN GO TO 6750
6800 GO SUB 6600
6810 FOR F=1 TO X
6820 PRINT AT C+11,D+1; INK 2;CHR$ J
6830 GO SUB 6630: NEXT F: RETURN
```

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Signature ______ Name ______

Address ______

Postcode ______

ZXC4/5

MELBOURNE HOUSE PUBLISHERS

Stock control

Keep efficient control of your stock with this splendid program written by Neil Streeter of Hastings.



This program for the 16K ZX81 allows the handling of stock control files.

Each file set up will deal with up to 100 stock items and will tell you which items require re-ordering. The program itself is menu driven and offers nine main options: you may enter or delete stock; enter the amount re-ordered; delete files or enter new items; save the file; or print out a list of all stock items and suppliers via the printer.

The subroutine for each option appears starting at line number 1000 multiplied by the option number. These are called in line 390 by GOTO 1000 * I, where I is the option chosen.

The option to save a file under a file name allows the facility to run several files, where each file contains stock of a certain kind. For example, one file could deal with food stock, another with sundries, and a further file could deal with stock for the office. In this way, it would be possible to have as many stock items as you wish on file. A further program could then be written, by the more enthusiastic of you, to index the files and what they contain.

As a last note, the product reference code should be unique to each item and should not be a sub-code of another item. For example, if you enter a code, food, and there already exists a code of this name, the computer will return the first found. However, the entry of the new items routine will tell you if a code already exists, so this should not cause any problem.

Spectrum conversion

The program is fairly straightforward and the listing self explanatory, and can be converted to run on the ZX Spectrum with minimal alterations.

First, alter the number in line 100 to 50 for the 16K Spectrum and 250 for the 48K Spectrum. Then, delete all the lines with FAST or SLOW in them. Finally, you may wish to change all the upper case messages to lower case, but this is not absolutely necessary.

```
  10 SAVE "STOC█"
  80 LET Z$="ENTER PRODUCT REFER
ENCE CODE."
 100 LET NO=100
 110 DIM A$(NO,32)
 112 DIM S$(NO,32)
 115 DIM A(100,4)
 200 SLOW
 210 PRINT TAB 9;"STOCK CONTROL.
";TAB 9;"█████████████"
 220 PRINT "OPTIONS:-"
 230 PRINT
 240 PRINT TAB 2;"1. ENTER NEW S
TOCK ITEM."
 250 PRINT TAB 2;"2. PRINT ITEM
DETAILS."
 260 PRINT TAB 2;"3. DELETE OLD
STOCK ITEM."
 270 PRINT TAB 2;"4. ENTER REMOV
ED STOCK."
 280 PRINT TAB 2;"5. ENTER STOCK
ON ORDER."
 290 PRINT TAB 2;"6. ENTER STOCK
RECEIVED."
 300 PRINT TAB 2;"7. PRINT ITEMS
TO RE-ORDER."
 310 PRINT TAB 2;"8. SAVE STOCK
FILE."
 315 PRINT TAB 2;"9. PRINT ALL R
EF. CODES";TAB 5;"AND SUPPLIERS."
 320 PRINT ,,"CHOOSE OPTION (1-9
)."
 330 PRINT TAB 9;"█████████████
"
 340 IF INKEY$<>"" THEN GOTO 340
 350 IF INKEY$="" THEN GOTO 350
 360 LET O$=INKEY$
 370 IF O$<"1" OR O$>"9" THEN GO
TO 340
 380 LET I=VAL O$
 390 GOTO 1000*I
1000 CLS
1010 PRINT Z$
1020 INPUT B$
1025 FAST
1030 FOR I=1 TO NO
```

```
1040 IF A$(I, TO LEN B$)=B$ THEN
 GOTO 1080
1050 IF A$(I,1 TO 4)="    " THEN
 GOTO 1100
1060 NEXT I
1065 SLOW
1070 PRINT ,,"NO MEMORY LEFT."
1075 PRINT ,,"PRESS ANY KEY TO R
ETURN TO MENU."
1076 IF INKEY$<>"" THEN GOTO 107
6
1077 IF INKEY$="" THEN GOTO 1077
1078 CLS
1079 GOTO 210
1080 SLOW
1085 PRINT ,,"STOCK ITEM ALLREAD
Y EXISTS."
1090 GOTO 1075
1100 SLOW
1102 PRINT "▶▶ ";B$
1110 LET A$(I)=B$
1120 PRINT ,,"ENTER AMOUNT IN ST
OCK."
1130 INPUT A(I,1)
1140 IF A(I,1)<0 THEN GOTO 1130
1150 PRINT "▶▶ ";A(I,1)
1160 PRINT ,,"ENTER AMOUNT ON OR
DER."
1170 INPUT A(I,2)
1180 IF A(I,2)<0 THEN GOTO 1170
1190 PRINT "▶▶ ";A(I,2)
1200 PRINT ,,"ENTER RE-ORDER LEV
EL."
1210 INPUT A(I,3)
1220 IF A(I,3)<0 THEN GOTO 1210
1230 PRINT "▶▶ ";A(I,3)
1240 PRINT ,,"ENTER RE-ORDER QUA
NTITY."
1250 INPUT A(I,4)
1260 IF A(I,4)<0 THEN GOTO 1250
1270 PRINT "▶▶ ";A(I,4)
1280 PRINT ,,"ENTER SUPPLIERS DE
TAILS."
1290 INPUT S$(I)
1300 IF S$(I, TO 4)="    " THEN
GOTO 1290
1310 PRINT S$(I)
1320 PRINT ,,"ANY FURTHER NEW IT
EMS (Y OR N)?"
1330 IF INKEY$<>"" THEN GOTO 133
0
1340 IF INKEY$="" THEN GOTO 1340
1350 LET Y$=INKEY$
1355 IF Y$="Y" OR Y$="N" THEN CL
S
1360 IF Y$="Y" THEN GOTO 1000
1370 IF Y$="N" THEN GOTO 200
1380 GOTO 1330
2000 CLS
2010 PRINT Z$
2020 INPUT B$
2030 IF B$="" THEN GOTO 2020
2035 FAST
2040 FOR I=1 TO NO
2050 IF A$(I, TO LEN B$)=B$ THEN
 GOTO 2080
2060 NEXT I
2065 SLOW
2070 PRINT ,,"PRODUCT DOES NOT E
XIST ON FILE."
2075 GOTO 1075
2080 CLS
2085 SLOW
2090 PRINT "PRODUCT DETAILS:-"
2100 PRINT ,,A$(I)
2110 PRINT ,,"PHYSICAL STOCK    :
";A(I,1)
2120 PRINT "QUANTITY ON ORDER:";
A(I,2)
2130 PRINT "TOTAL STOCK      :";
A(I,1)+A(I,2)
2140 PRINT "RE-ORDER LEVEL   :";
A(I,3)
2150 PRINT "RE-ORDER QUANTITY:";
A(I,4)
2160 PRINT   "SUPPLIER:-"
2170 PRINT S$(I)
2180 PRINT ,,"PRESS ""C"" FOR CO
PY, ANY OTHER  KEY FOR MENU."
2190 IF INKEY$<>"" THEN GOTO 219
0
2200 IF INKEY$="" THEN GOTO 2200
2210 IF INKEY$="C" THEN COPY
2220 CLS
2230 GOTO 200
3000 CLS
3010 PRINT Z$
3020 INPUT B$
3025 FAST
3030 FOR I=1 TO NO
3040 IF A$(I, TO LEN B$)=B$ THEN
 GOTO 3070
3050 NEXT I
3055 SLOW
3060 GOTO 2070
3070 SLOW
3080 PRINT ,,"PRESS ""D"" TO DEL
ETE, ANY OTHER  KEY TO RETURN TO
 THE MENU."
3081 IF INKEY$<>"" THEN GOTO 308
1
3082 IF INKEY$="" THEN GOTO 3082
3083 IF INKEY$="D" THEN GOTO 308
8
3084 CLS
3085 GOTO 200
3088 FAST
3089 FOR J=I+1 TO NO
3090 LET A$(J-1)=A$(J)
3100 LET S$(J-1)=S$(J)
3110 FOR K=1 TO 4
3120 LET A(J-1,K)=A(J,K)
3130 NEXT K
3140 NEXT J
3150 NEXT K
3160 PRINT ,,"PRODUCT DELETED."
3165 SLOW
3170 GOTO 1075
4000 CLS
4010 PRINT Z$
4020 INPUT B$
4030 IF B$="" THEN GOTO 4050
4035 FAST
4040 FOR I=1 TO NO
4050 IF A$(I, TO LEN B$)=B$ THEN
 GOTO 4090
4060 NEXT I
4065 SLOW
4070 GOTO 2070
4090 SLOW
4091 PRINT ,,B$
4092 PRINT "TOTAL STOCK=";A(I,1)
+A(I,2)
4095 PRINT ,,"ENTER AMOUNT REMOV
ED FROM STOCK."
4100 INPUT A
4110 IF A<0 THEN GOTO 4100
4111 IF A(I,1)-A<0 THEN PRINT ,,
"NOT POSSIBLE, THAT QUANTITY OF
STOCK IS NOT YET AVAILABLE."
4112 IF A>A(I,1) AND A(I,2)>0 TH
EN PRINT ,,"AWAITING DELIVERY OF
-"
4113 IF A(I,1)+A(I,2)<A THEN PRI
NT ,,"ORDER ";ABS (A(I,1)+A(I,2)
-A);" OF:-"
4114 PRINT ,,A$(I)
4119 IF A(I,1)-A<0 THEN GOTO 414
0
4120 LET A(I,1)=A(I,1)-A
4130 PRINT "▶▶ ";A
4140 PRINT ,,"ANY FURTHER STOCK
REMOVED (Y/N)?"
4150 IF INKEY$<>"" THEN GOTO 415
0
4160 IF INKEY$="" THEN GOTO 4160
4170 IF INKEY$="Y" THEN GOTO 400
0
4175 CLS
4180 GOTO 200
5000 CLS
5010 PRINT Z$
5020 INPUT B$
```

```
5030 IF B$="" THEN GOTO 5030
5040 FAST
5050 FOR I=1 TO NO
5060 IF A$(I, TO LEN B$)=B$ THEN
 GOTO 5100
5070 NEXT I
5080 SLOW
5090 GOTO 2070
5100 SLOW
5110 PRINT ,,B$
5120 PRINT ,,"ENTER AMOUNT ON OR
DER."
5130 INPUT A
5140 IF A<0 THEN GOTO 5130
5150 PRINT ">> ";A
5160 LET A(I,2)=A(I,2)+A
5170 PRINT ,,"ANY MORE STOCK ON
ORDER (Y/N)?"
5180 IF INKEY$<>"" THEN GOTO 518
0
5190 IF INKEY$="" THEN GOTO 5190
5200 IF INKEY$="Y" THEN GOTO 500
0
5210 CLS
5220 GOTO 200
6000 CLS
6010 PRINT Z$
6020 INPUT B$
6030 IF B$="" THEN GOTO 6020
6040 FAST
6050 FOR I=1 TO NO
6060 IF A$(I, TO LEN B$)=B$ THEN
 GOTO 6100
6070 NEXT I
6080 SLOW
6090 GOTO 2070
6100 PRINT ,,B$
6110 PRINT ,,"ENTER AMOUNT RECEI
VED."
6120 INPUT A
6130 LET A(I,1)=A(I,1)+A
6140 LET A(I,2)=A(I,2)-A
6150 IF A(I,2)<0 THEN LET A(I,2)
=0
6160 PRINT ">> ";A
6170 PRINT ,,"ANY FURTHER STOCK
RECEIVED (Y/N)"
6180 IF INKEY$<>"" THEN GOTO 618
0
6190 IF INKEY$="" THEN GOTO 6190
6200 IF INKEY$="Y" THEN GOTO 600
0
6210 CLS
6220 GOTO 200
7000 FAST
7005 LPRINT "PRODUCTS REQUIRING
RE-ORDERING."
7010 LPRINT "████████████████████████
████████"
7015 LET A=0
7020 FOR I=1 TO NO
7030 IF A$(I, TO 6)="      " THE
N GOTO 7500
7040 IF A(I,1)+A(I,2)>A(I,3) THE
N GOTO 7200
7045 LET A=1
7050 LPRINT
7060 LPRINT "PRODUCT:-"
7070 LPRINT A$(I)
7080 LPRINT "SUPPLIER:-"
7090 LPRINT S$(I)
7100 LPRINT "RE-ORDER QTY. ";A(I
,4)
7110 LPRINT "-------------------
-------------"
7200 NEXT I
7500 CLS
7505 IF A=0 THEN LPRINT "NONE."
7510 SLOW
7520 GOTO 200
8000 CLS
8010 PRINT TAB 8;"SAVE STOCK FIL
E.",,"████"
8020 PRINT ,,"ENTER FILE NAME."
8030 INPUT B$
8040 IF B$="" THEN GOTO 8030
8045 PRINT ">> ";B$
8060 PRINT ,,"START TAPE REORDER
 AND PRESS ANYKEY TO SAVE FILE."
8070 IF INKEY$<>"" THEN GOTO 807
0
8080 IF INKEY$="" THEN GOTO 8080
8090 SAVE B$
8100 CLS
8110 PRINT "FILE ";B$
8115 PRINT
8120 GOTO 200
9000 FAST
9005 LPRINT "STOCK/SUPPLIERS LIS
T.",,"████████████████████████"
9010 FOR I=1 TO NO
9020 IF A$(I, TO 6)="      " THE
N GOTO 9500
9025 LPRINT
9030 LPRINT "STOCK REF. CODE."
9040 LPRINT A$(I)
9050 LPRINT "SUPPLIER."
9060 LPRINT S$(I)
9070 NEXT I
9500 CLS
9505 SLOW
9510 GOTO 200
```

```
          STOCK CONTROL.

OPTIONS:-

  1. ENTER NEW STOCK ITEM.
  2. PRINT ITEM DETAILS.
  3. DELETE OLD STOCK ITEM.
  4. ENTER REMOVED STOCK.
  5. ENTER STOCK ON ORDER.
  6. ENTER STOCK RECEIVED.
  7. PRINT ITEMS TO RE-ORDER.
  8. SAVE STOCK FILE.
  9. PRINT ALL REF. CODES
     AND SUPPLIERS.

CHOOSE OPTION (1-9).

ENTER PRODUCT REFERENCE CODE.
>> FOOD/STOCK C230D

ENTER AMOUNT IN STOCK.
>> 23

ENTER AMOUNT ON ORDER.
>> 43

ENTER RE-ORDER LEVEL.
>> 12

ENTER RE-ORDER QUANTITY.
>> 20

ENTER SUPPLIERS DETAILS.
B. BARTON. LTD.

ANY FURTHER NEW ITEMS (Y OR N)?

PRODUCT DETAILS:-

FOOD/STOCK C230D

PHYSICAL STOCK     :23
QUANTITY ON ORDER:43
TOTAL STOCK        :66
RE-ORDER LEVEL     :12
RE-ORDER QUANTITY:20

SUPPLIER:-
B. BARTON. LTD.

PRESS "C" FOR COPY, ANY OTHER
KEY FOR MENU.

PRODUCTS REQUIRING RE-ORDERING.
```

Example outputs from the program.

Bookshelf

Patrick Cain takes a long, hard look at the latest publications for your ZX library.

Introducing Spectrum Machine Code — Ian Sinclair

If you have only recently unpacked your Spectrum then take heed; enjoy what you are doing and the power a command of BASIC gives you, and for a while steer clear of machine code. On the other hand, if you are already familiar with Spectrum BASIC and are seeking to increase the power and speed of your machine by programming directly in machine code then 'Introducing Spectrum Machine Code' by Ian Sinclair is a handy companion to have.

The 135 pages and seven appendices set out to give an extensive, if not always detailed, introduction to machine code and the operations and functions of the bits that lie below the keyboard. The book will not, and does not attempt to, turn the reader into a competant machine code programmer, but that is not a shortcoming, it is designed to introduce machine code to beginners (such is the nature and extent of the subject that no one book is sufficient to offer complete knowledge).

In the early chapters, Mr Sinclair (no relation to the obvious) introduces the RAM, the ROM, the MPU and with clear examples describes the relationship between them. Subsequent chapters take task with binary and hexadecimal notation, introduce assembly language and examine the use of registers. Each section is fully highlighted by worked examples that require and assume minimal previous knowledge. Finally, through the introduction of flow diagrams, simple machine code routines are developed.

Throughout, the book is, where possible, jargon free, the text is always conscious that it is aimed at newcomers and its strength is that it never attempts to go too far into this confusing subject too soon. However, where it is deficient is in the number of final machine code program examples that are included; but since a number of recommendations for further reading are made this is not such a great problem.

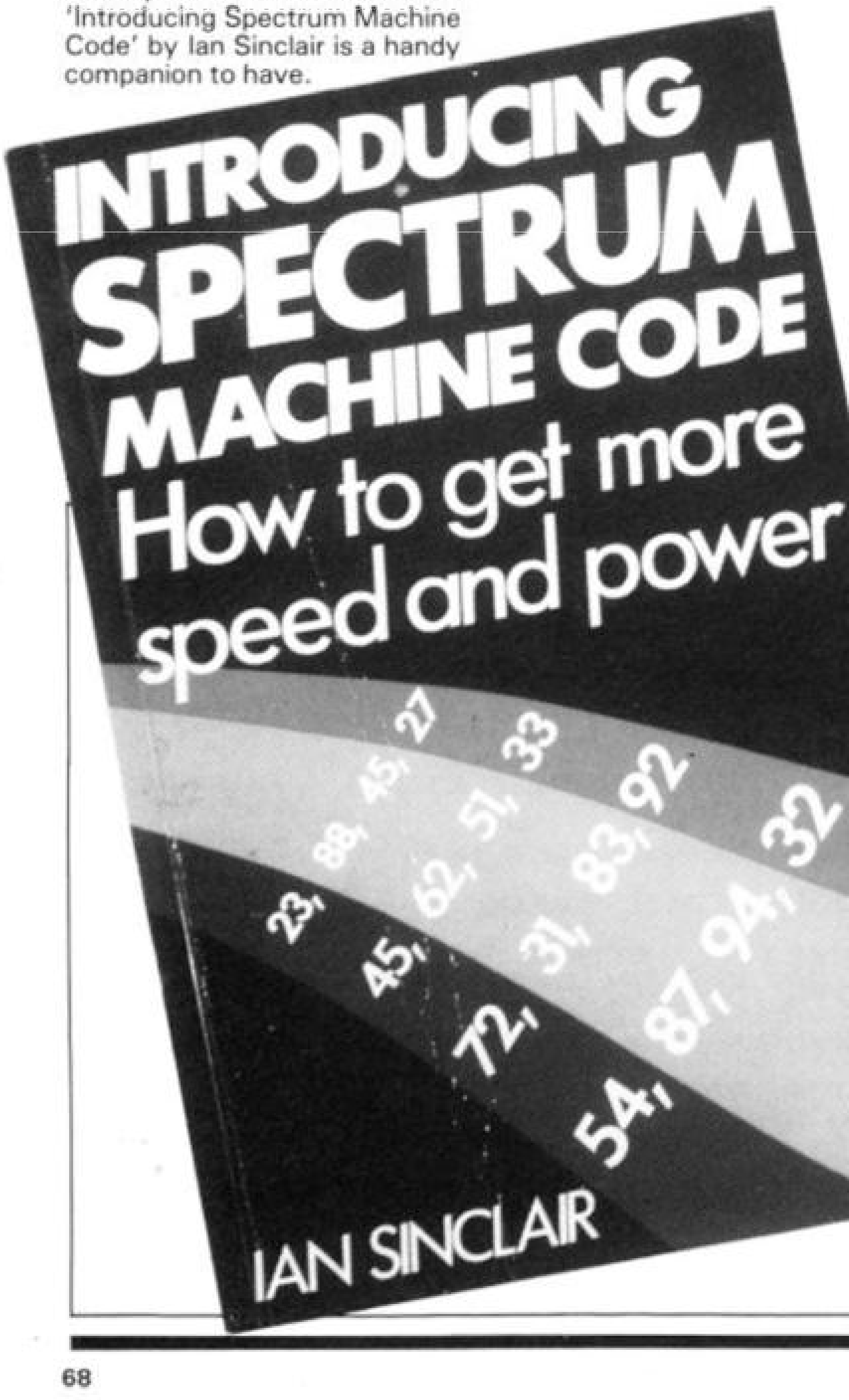
Whether it is your intention to become a master of machine code or simply to make some sense of more advanced BASIC programs, if you are well acquanted with BASIC then this book will make your understanding of the Spectrum, and most other micros, far deeper.

Published by Granada Publishing, Introducing Spectrum Machine Code is written by Ian Sinclair and costs £7.95. ISBN 0 246 120827

The Art Of Programming The 16K ZX81 — SM Gee and M Jones

Adding memory to a computer adds to the power and potential of the computer. Efficient use of the new potential often requires more advanced approaches to programming. M James and SM Gee, authors of 'The Art Of Programming the 1K ZX81', have written a follow-on book, not surprisingly called 'The Art Of Programming The 16K ZX81', which looks at the enlarged scope of the '81 with a RAM pack and at programming techniques beyond those required for the unexpanded machine.

Although the ZX81 has many functions available, its capability is greatly hampered by its lack of memory. Similarly, if your only user experience has been with a 1K machine, your own programming ability may be equally restricted. The authors have attempted to increase the reader's skill in programming now that the extra memory has provided the opportunity, a task which I think they have successfully met in this pocket-sized edition.





Chapter one is an unnecessary justification for writing the book and a wishy washy commentary on the printer and RAM pack. Chapter two looks at what extra memory the RAM pack gives, what is stored where and how to manipulate these memory locations for better effect. Three utility programs Memory Use, Variable Use and Line Remember are included in the following chapter to provide the necessary knowledge and assistance in putting larger programs together and subsequently into operation. In the fourth chapter, there is an interlude from the more serious applications providing four good quality games programs. 'Depth Charge' a missile and target game exemplifies practical methods for moving graphics characters around the screen. The others draw to notice techniques like screen PEEKing and POKEing, scrolling and paged graphics, with simple explanations of where they might be put to good use. Understanding fancy techniques may be fine, but it is certainly of little use unless you know how to incorporate them into your own programs. Thankfully, this wide ranging little book has taken this too into consideration and later pages deal with designing larger programs.

Equally well dealt with is storing and recalling data from tape and methods for improving the range of the printer. Finally, to whet your appetite further after putting the RAM pack to good use, there is a chapter that introduces machine code. The information about formatting machine code routines is small but as a guide to just what is capable with machine code on a ZX81, it is complete.

The Art Of Programming The 16K ZX81 is published by Bernard Babani, written by SM Gee and M Jones, costs £2.50 and as a guide to the larger '81 it is an excellent compliment.
ISBN 0 85934 089 9

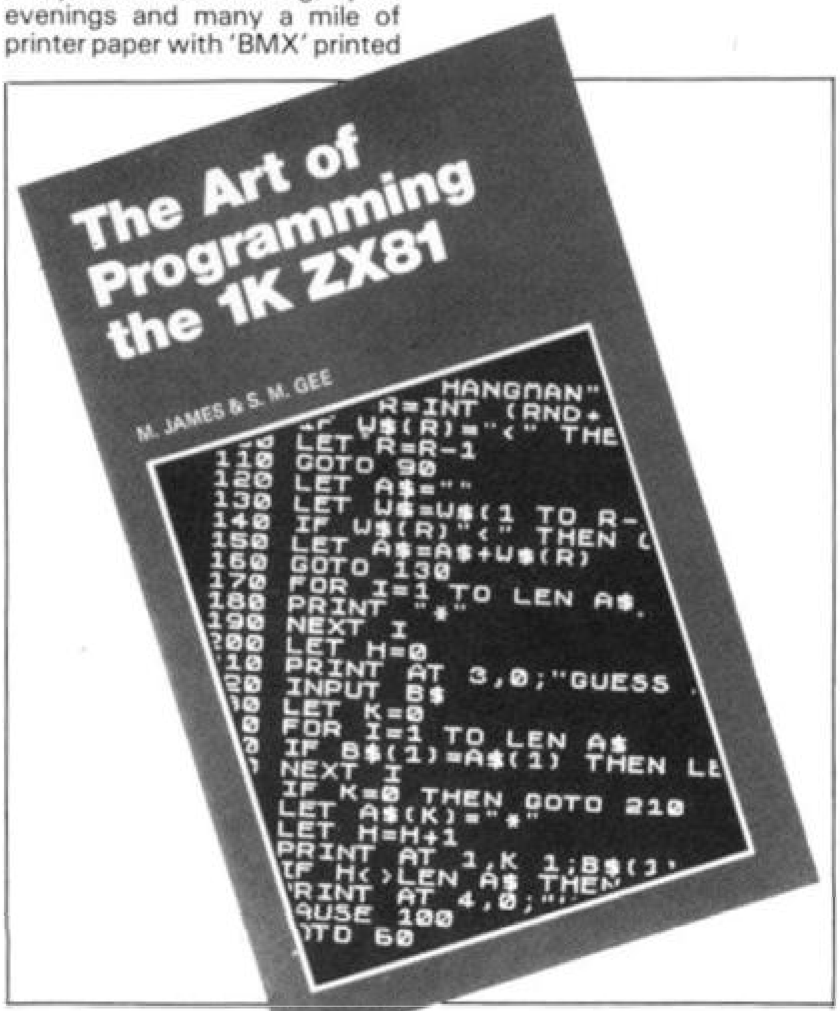
The Art Of Programming The 1K ZX81 — Mike James and SM Gee

A review by James Walsh

Finding it difficult to do anything worthwhile in 1K RAM? Could this be the answer (well, it is cheaper than a 16K RAM pack) – at £1.95 what have you got to lose?

OK, how about starting from the beginning, 'The Art of Programming the 1K ZX81' is written by M James and SM Gee, and published by Bernard Babani Ltd. It is a thin volume of about 85 pages with a printer listing on the front and the preface written on the back! The first thing you come to inside the book is an expanded version of what is written on the back cover. The contents of the book are split up into eight chapter headings: Making the most of your ZX81 (I seem to have heard that phrase somewhere before); Randomness; Graphics; Moving graphics; PEEK and POKE; A Sense of Time; Strings and Words; and finally, Hints and tips.

It is basically aimed at the owners of XZ81s who have mastered the basic operations of plugging it in and turning it on, but have had limited success with the manual itself. A frightened yelp from the dog as he hurriedly ducked to avoid a hurtling copy of the ZX manual reminded me of the ideal person to read the book, (no, not the dog, he's more into Hi-res graphics) — my younger brother who had always been keen to learn but had found the Sinclair manual the major stumbling block. Well, I thought, at least this book is a little thinner and less likely to knock the dog unconcious, so how about giving it a try. After some long, quiet evenings and many a mile of printer paper with 'BMX' printed on it, there were a number of interesting observations he came up with.



Though the book was written for the complete novice, rather much was presumed as far as previous experience was concerned. Though some of the functions such as RAND were well explained, some functions were not looked into in enough detail, and gave cause for concern when it came to the programs themselves.

Though the programs were quite good, they were in some ways too good and lost the reader, leaving him with major doubts. Poor explanations were given for some of the programs, which meant that the reader was often left with the feeling that they did not, in fact, work!

I was quite amused by one comment in the first chapter explaining how the ZX81 is the successor to Sinclair's first hand-held computer, the ZX80. I have heard the Sinclair ZX80 being called many a name, but never 'hand-held'!!!

Though the book sets out quite admirably, it leaves some gaps, and, in fact, goes too far too fast. Maybe with a little more time and twice as many pages, it could turn out to be a better book. But time is something that we do have, as already they have lost much of their market in Britain with the introduction of the Spectrum.

All things considered if money is short and the manual is used in conjunction with this book, then it would make a quite reasonable combination. **JW**

The Art Of Programming The 1K ZX81, published by Bernard Babani, is written by M James and SM Gee and is priced at £1.95.
ISBN 0 85934 084 8

The Spectrum Companion — Bob Maunder

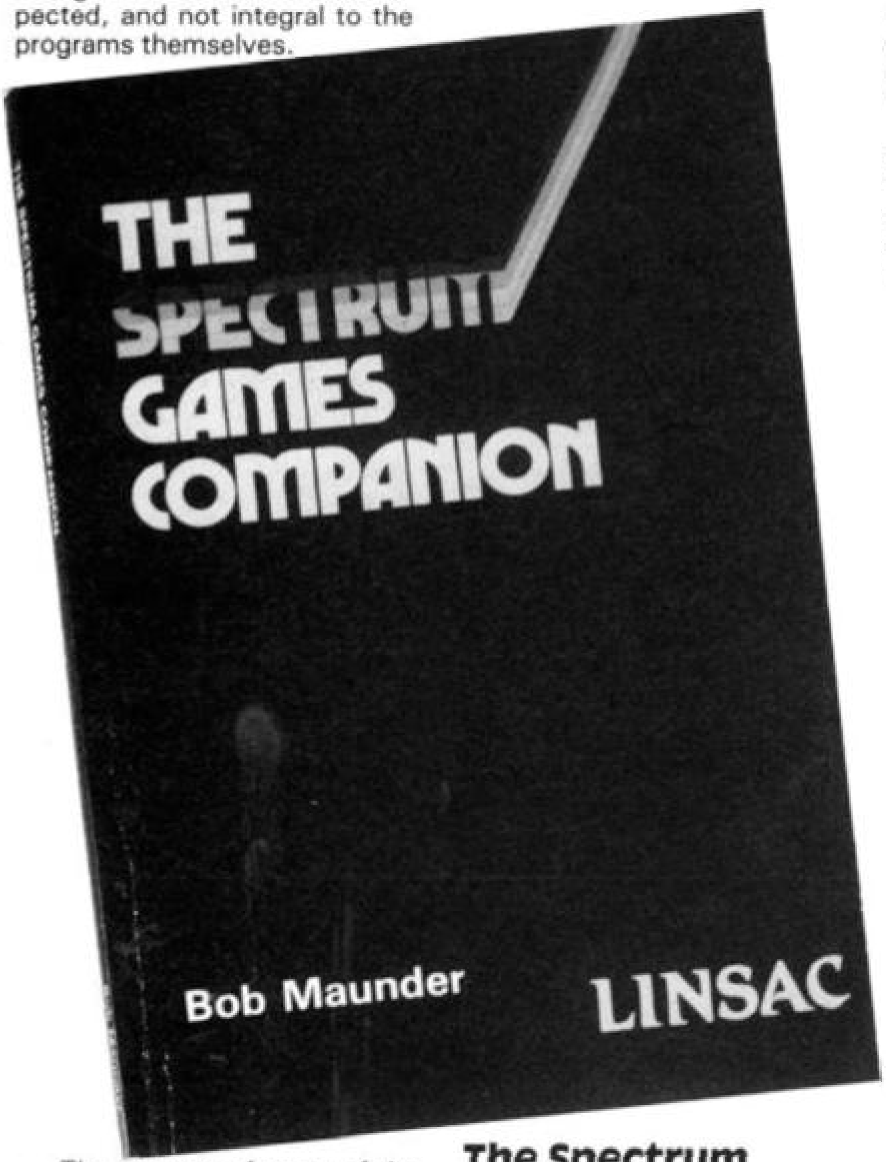
'The ZX Spectrum Companion' by Bob Maunder is in design similar to many other games books published for the Spectrum. Many attempt to offer both exciting and educational games that make full use of the Spectrum's capabilities and at the same time aim to teach by a proliferation of methods the art of program writing. Boasts that are fulfilled to varying degrees! With Mr Maunder's background as an educationalist, it is natural that his book should lean more to instruction.

The book begins by laying down a 'good programming practice' for designing Spectrum games that takes the reader step by step from conceiving or translating an idea to a final listing. To a beginner, any lessons on program writing by a senior lecturer in Computer Science has got to be worthy of notice. Has he been able to translate his undoubted knowledge effectively to print? Bob Maunder and I both feel that he has. From his early enquiries about what the qualities of a good game are to methods for translating the final ideas into BASIC, the description at each methodical stage is detailed and clear. Crystalising the idea — how the game will start, what the play is expected to do, what will the screen look like; stepwise refinement of the program method and writing the basic program are planned at each stage before approaching the computer — better for getting rid of bugs than D.D.T. Not then too great a surprise to discover that each of the 21 programs are well structured, mindful of memory and an example to all of us of the way programs ought to be written.

To be found with each of the programs is an account of its purpose, an entry of the method used to create it and notes of explanation; indeed each includes an example of the

guideline laid down at the beginning of the book.

Where unfortunately the programs have not followed the example of the guidelines has been in observing the qualities of a good game. I found few of the programs in the book to be particularly good ones. Seven categories of games are to be found, number games, word games, board, simulation, dice, card and grid games. None of these, with perhaps the exception of the simulation games, seemed to make much of the scope that the graphics on board the Spectrum provide. While both the sound and graphics were used in nearly all of the games, their effect or application was not terribly impressive and certainly not utilised to their full. The screen images and sounds produced appeared to me to be more of an afterthought used because it was expected, and not integral to the programs themselves.



The essence of many of the games seemed to be number manipulation, like the type which were available on previous generation computers, before the development of user graphics. 'Money Match' is one of this type, based on the American casino game Keno, it requires the player to guess eight numbers from a series of 20, randomly selected between one and 80. The player is given £20 pounds and has to bet this on his choice. The game continues until the player runs out of money or dies of boredom. In fairness 'Sink the Ship', 'Simon' and 'Dead Ducks' are worthy of mention. Of the others, the best were those games which had been adapted from favourites such as 'Blackjack', 'Solitaire' and 'Concentration'; unfortunately they have gained nothing in their translation to computer, and frankly I would rather play the originals anytime.

As a teaching manual on how to write games programs, The Spectrum Games Companion is published by Linsac, written by Bob Maunder and costs £5.95. ISBN 0 907211 02 X

The Spectrum Book Of Games — M James, SM Gee and K Ewbank

'The Spectrum Book Of Games', a clearly printed well labelled compendium of game programs by three authors, M James, SM Gee and Kay Ewbank, is a witness to the unfortunate truth that good computer programmers were not necessarily good inventors of games. Why else with so many game programs produced should 'Invaders', 'Asteroids' and their variants still be as popular?

Each of the 21 programs are well written and while lengthy are still within the range of the 16K Spectrum. Each too has been dumped from PRINT to ensure no listing errors, and by substituting for the ZX printer a clearly legible printout has been attained.

Accompanying texts include a structure of the subroutines used, typing tips, each of which remind the user to look out for the same things and equally worthless suggestions for future developments. 'Save the Whale', for example, a program running to four pages in length might be altered by "adding a waterspout to the whale that was printed at every other move", personally I preferred to 'Save the Effort'.

Of the games themselves, I enjoyed 'Mighty Missiles' and 'Bobsleigh', both variations on old favourites, and a new one called 'Guideline', a development of the game in which a metal hook is guided along a wire without allowing them to come into contact and hence cause a buzzer to sound. 'Spectrum Invaders' was repetitive and tame, with no battlements to defend or hide behind and no bonus points on offer. Of the others, 'Mirror Tile', a tile puzzle with an infinite number of solutions and 'Captive The Quark' have been transformed successfully to Spectrum and were probably the best.

Throughout, the graphics were of a good standard and the sound is used to great effect, no more so than in 'Spectrum Ledger' — a simulation horse race that starts with the computer playing the tune Camptown Races. Unfortunately, the game deteriorates somewhat after this with the player asked to bet on a race of five horses. The result is totally random and requires no skill. For entertainment value the game, like the player, is a loser.

The Spectrum Book Of Games is written by Mike James, S M Gee and Kay Ewbank, published by Granada Publishing, contains 21 programs and costs £5.95. ISBN 0 246 12047 9



Microchips With Everything — Edited by Paul Sieghart

As the user of a microcomputer, you are in contact with the latest technology. Growing side by side with the microcomputer is something infinitely larger. Both owe their existence to the microchip. Coupled to the advancements in communications, the microchip is responsible for Information Technology (I.T.). I.T. is so significant that the Government called 1982 the Year of Information Technology, it prompted enquiries and discussions from all corners of Great Britain. I.T. is so significant that it will sooner rather than later affect you. It is also the subject of a new book published to question I.T.

'Micro-Chips With Everything' is not a book of detail or instruction, rather it is one of discussion. More accurately of five discussions that took place during I.T. year at the invitation of the Institute of Contemporary Arts. The subject discussed at each of the meetings was I.T.'s consequences: The Social and Political Implications of Information Technology, and in the manner of true discussion the views of many sides of society were represented. Each of the meetings had specific subjects to debate: 'I.T. Doom or Boom', 'The Third World', 'Independance or Dependance', 'Work and/or Leisure?', 'Privacy: A Free or Secret State?', 'The Mass Media: Diversity or Standardization?'; each is given a chapter of the book. Those offering the views reflect a variety of interests; Shirley Williams and Christopher Price, both M.P.s; Mike Cooley and Clive Jenkins, both Trade Unionists. Also included were Brenda Maddox representing economists and Dr John Dawson representing the medical profession. David Fairbairn and Jonathan Gershinny from the field of science and others who were considered or consider themselves to be concerned sufficiently to voice their opinion are also represented. And, as the books preface rightly points out, I.T. is the concern of everyone and not the preserve of those in power or those at play with user ports behind dark doors.



Of course, politicians can be relied upon to give their political play, conservationalists can be expected to cry wolf and scientists to welcome their newfound baby; but the consequences of I.T. are so far reaching that the views of all of the contributors are worth taking notice of.

Is it as it is claimed to be 'an unusually powerful opportunity to reduce the gap between the developed . . . and the developing world' or will it 'increase inequalities between the First and Third World Countries?' Can we 'use it for welfare to create jobs' or will it 'deny human beings any form of self expression and reduce them to an appendage of the machine?'. In answering the many questions that continue to be asked of I.T., the speakers bring a depth of understanding beyond most of us, a wealth of specialist knowledge and a deal of forethought. Those questions will remain unanswered well into the future but that is no reason for not asking them in the first place. I.T. is likely to, whatever you do, affect you; it is worthy of your concern.

Micro-Chips With Everything, is edited by Paul Sieghart, published by Comedia and costs £3.95.
ISBN 0 906890 32 2

Machine code colour graphics

Robert Erskine shows you how to speed up your colour graphics on the ZX Spectrum.

Although Spectrum BASIC is fairly fast, there are many occasions when it is not nearly fast enough; particularly when you need to print large or multiple images to the screen.

The most efficient way of solving this problem is to use machine code routines to do the job, for the speed of the Spectrum's microprocessor is such that several graphics, or even the entire screen, can be printed in a small fraction of a second. Although there is a routine in the ROM which enables you to do this (using an RST 10 instruction) the process can be rather long winded unless each character in the graphic follows the previous one on the screen. Furthermore, since this routine draws its graphics symbols from existing memory, you will always be confined to using the standard character set and user defined graphics.

What would be ideal would be a program which enables you to 'read' every byte of your most complex graphic masterpieces and store them away in RAM for instant recall to any position on the screen. The two programs in this article, Grafcode and Grafprint, are designed to do exactly that.

Dynamic duo

Grafprint is a machine code program which builds up a graphic image on the screen, including attributes, from a data file held in memory. It can either be called from within a BASIC program or incorporated in a larger machine code program where it can be used to greater effect in generating laser fire or swooping aliens.

The Demo program illustrates Grafprint at work, printing a large green moon lander at the top left of the screen. By altering lines 20 and 30 which hold the low and high byte values of the first attribute position on the screen, you will see that the image can be printed anywhere, in spite of the peculiar design of the Sinclair display file.

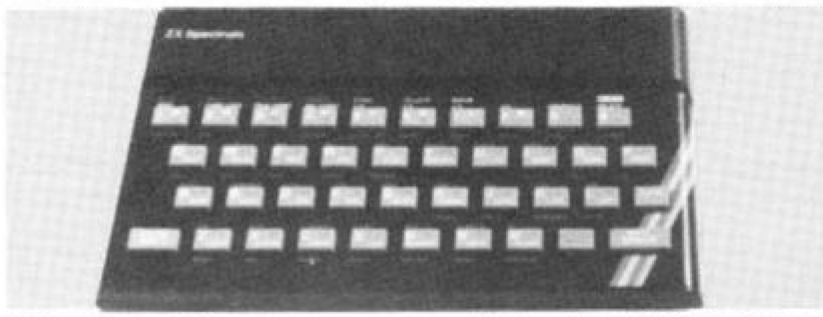
Line 90 of Demo holds the machine code data of Grafprint and line 100 holds the data for the graphic.

The Grafprint program is designed to be loaded from address 32300 to address 32411 and therefore RAMtop should be at 32299 or less. The first eight bytes are used as temporary pigeon holes by the main program, which starts at 32308. Although Grafprint can be moved elsewhere in memory, it contains references to these first eight bytes and these would therefore have to be changed.

Grafcode is a BASIC program which generates data files of graphics for Grafprint. To use it, first create your graphic image (or text) anywhere on the screen, preferably from the top left-hand corner where you can find the start address easily. The image may be created in the normal way, using BASIC colour commands, user defined graphics and so on. Then, when it is ready, activate Grafcode by entering the command GO TO 9600. On no account RUN the program or your splendid new handiwork will disappear without trace.

What's in store?

You will then be prompted to input the address from which you want the graphics data to be stored, the *first* attribute address currently occupied by the graphic and the number of character squares in the graphic. You will then be asked to input each of the displacements between the characters. These refer to attribute file displacements so that one square to the right = 1, one square below = 32, and so on. You may then sit back and hum a little tune for a few seconds whilst Grafcode translates your handiwork into a sequential data file which can be accessed by Grafprint.



Having loaded Grafprint and prepared your data file, the next step is to load the start address of the data file into 32302/3 and the attribute address of the chosen screen location into 32300/1. Obviously in a moving graphics program, this would be done in machine code. To print the graphic to the screen, simply enter the command RANDOMIZE USR 32308.

Grafprint works by moving a pointer around the attributes file of the Spectrum and loading the attributes of the current character into an address, followed by the corresponding eight display file bytes for each character. The data file which it reads is formatted so that each character is represented by 10 bytes. The first byte holds the displacement between the current character and the one before, the second holds the attributes code and the remaining eight hold the graphic image. The data for the first character in a graphic also uses 10 bytes but instead of starting with a displacement value, it holds the total number of characters in the graphic.

The program incorporates a routine which calculates which of the three screen zones the current character will occupy and selects the corresponding display addresses accordingly. This ensures that if the graphic crosses a border between zones then the relative positions of the characters are maintained.

The sky's the limit

There is no limit to the size of the data file which can be used by Grafprint, other than the size of your machine's memory, and if files are built up section by section, there is no limit to the different shapes you can store. Having used 21 user defined graphics in a picture you can convert it to data using Grafcode, store it temporarily on tape and continue with a new set of graphics, bringing the whole lot together in one file when you have finished. Graphics involving circles and other shapes can equally be stored.

If you intend to move graphics rapidly around the screen using Grafprint, it will be necessary to erase each preceding image before printing the next. One way of doing this is to use a machine code equivalent of PRINT OVER, say by holding a blank graphic of the same size and shape as the original and using Grafprint to print it over the top. In some cases, it will be sufficient to clear the screen between each printing because the speed of machine code is such that the illusion of continuous action will be maintained. Screen clearing can be achieved by filling all the display file addresses with zeros and all the attribute addresses with an appropriate code. If the background to your moving graphics is complex and you don't wish to clear it between moves, you can store a complete copy of the screen above RAMtop using a block move routine in machine code and reprint it to the screen between moves by means of a similar routine. Since this technique uses up nearly seven thousand bytes of RAM it is hardly worth contemplating on a 16K Spectrum, unless the rest of your program is entirely in machine code.



```
Enter as a direct command:
RANDOMIZE USR 32308
```

The moon lander graphic printed when the Demo program is RUN.

```
   1 REM DEMO
  10 CLEAR 32299
  20 POKE 32300,0
  30 POKE 32301,88
  40 POKE 32302,156
  50 POKE 32303,126
  60 FOR x=32308 TO 32451
  70 READ byte: POKE x,byte
  80 NEXT x
  90 DATA 42,46,126,235,42,44,12
6,26,50,48,126,19,26,119,213,34,
50,126,235,33,255,88,167,237,82,
56,11,42,50,126,17,0,24,167,237,
82,24,32,237,91,50,126,33,255,89
,167,237,82,56,11,42,50,126,17,0
,17,167,237,82,24,9,42,50,126,17
,0,10,167,237,82,209,19,6,8,26,1
19,5,40,4,36,19,24,247,42,50,126
,58,48,126,6,1,144,200,50,48,126
,19,26,6,0,79,9,24,163
 100 DATA 4,60,63,127,225,255,25
5,127,63,31,1,60,252,254,135,255
,255,254,252,248,31,60,15,24,48,
96,255,128,128,128,1,60,240,24,1
2,6,255,1,1,1
 110 PRINT AT 20,0;"Enter as a d
irect command:";AT 21,0;"RANDOMI
ZE USR 32308"
```

The listing of the Demo program.

```
   1 REM GRAFCODE
9600 PRINT AT 21,0;"Enter data s
tart"
9605 INPUT data: LET dat=data
9610 PRINT AT 21,0;"Enter first
att address"
9615 INPUT att
9620 PRINT AT 21,0,"How many cha
racters in graphic?"
9625 INPUT char: DIM d(1): IF ch
ar>1 THEN DIM d(char-1)
9630 POKE data,char: LET data=da
ta+1
9632 IF char=1 THEN GO TO 9655
9635 FOR x=1 TO char-1
9637 PRINT AT 21,0;"
9640 PRINT AT 21,0;"Displacement
 ";x;"?                         "
9645 INPUT d(x)
9650 NEXT x
9655 FOR x=1 TO char
9660 POKE data,PEEK att
9665 IF att<22784 THEN GO TO 969
5
9670 IF att<23040 THEN GO TO 968
5
9675 LET byte=att-2560
9680 GO TO 9700
9685 LET byte=att-4352
9690 GO TO 9700
9695 LET byte=att-6144
9700 LET count=0
9705 LET data=data+1
9710 POKE data,PEEK byte
9715 LET count=count+1
9720 IF count=8 THEN GO TO 9735
9725 LET byte=byte+256
9730 GO TO 9705
9735 LET data=data+1
9740 IF x<char THEN POKE data,d(
x)
9745 IF x<char THEN LET att=att+
d(x)
9750 LET data=data+1
9755 NEXT x
9760 PRINT AT 21,0;"Done-from ";
dat
9765 STOP
```

The listing of the Grafcode program.

Grafprint disassembled

Addr	Hex code	Mneumonic	
7E2C	00		
7E2D	58		
7E2E	9C		
7E2F	7E		
7E30	000000		
7E33	00		
7E34	2A2E7E	LD	HL, (7E2Eh)
7E37	EB	EX	DE,HL
7E38	2A2C7E	LD	HL,(7E2Ch)
7E3B	1A	LD	A,(DE)
7E3C	32307E	LD	(7E30h),A
7E3F	13	INC	DE
7E40	1A	LD	A,(DE)
7E41	77	LD	(HL),A
7E42	D5	PUSH	DE
7E43	22327E	LD	(7E32h),HL
7E46	EB	EX	DE,HL
7E47	21FF58	LD	HL,58FFh
7E4A	A7	AND	A,A
7E4B	ED52	SBC	HL,DE
7E4D	380B	JR	C, +0Bh
7E4F	2A327E	LD	HL,(7E32h)
7E52	110018	LD	DE,1800h
7E55	A7	AND	A,A
7E56	ED52	SBC	HL,DE
7E58	1820	JR	+20h
7E5A	ED5B327E	LD	DE,(7E32h)
7E5E	21FF59	LD	HL,59FFh
7E61	A7	AND	A,A
7E62	ED52	SBC	HL,DE
7E64	380B	JR	C, +0Bh
7E66	2A327E	LD	HL,(7E32h)
7E69	110011	LD	DE,1100h
7E6C	A7	AND	A,A
7E6D	ED52	SBC	HL,DE
7E6F	1809	JR	+09h
7E71	2A327E	LD	HL,(7E32h)
7E74	11000A	LD	DE,0A00h
7E77	A7	AND	A,A
7E78	ED52	SBC	HL,DE
7E7A	D1	POP	DE
7E7B	13	INC	DE
7E7C	0608	LD	B,08h
7E7E	1A	LD	A,(DE)
7E7F	77	LD	(HL),A
7E80	05	DEC	B
7E81	2804	JR	Z, +04h
7E83	24	INC	H
7E84	13	INC	DE
7E85	18F7	JR	−09h
7E87	2A327E	LD	HL,(7E32h)
7E8A	3A307E	LD	A,(7E30h)
7E8D	0601	LD	B,01h
7E8F	90	SUB	A,B
7E90	C8	RET	Z
7E91	32307E	LD	(7E30h),A
7E94	13	INC	DE
7E95	1A	LD	A,(DE)
7E96	0600	LD	B,00h
7E98	4F	LD	C,A
7E99	09	ADD	HL,BC
7E9A	18A3	JR	−5Dh
7E9C	0138F0	LD	BC,F038h

Control Bytes

The Hobbit

Phil Garratt, after a brief sojourn in Middle Earth, takes time off to tell us what he found there.

The Hobbit — Melbourne House

Once upon a time, a young professor, bored to distraction with marking School Certificate exam papers, wrote on a blank sheet of paper 'In a hole in the ground there lived a hobbit'. That was over fifty years ago, and at the time neither the professor, J R R Tolkien, nor anyone else had any idea what a hobbit was. Eventually the story was told, and ever since, The Hobbit has been one of the most popular and best loved children's books. Its popularity and that of The Lord of the Rings which followed, is matched only by the seriousness with which some Tolkein fans dissect the books for allegorical meaning, never intended by the author. So it takes a brave group of people to set out on an 18 month adventure to re-write The Hobbit as a computer game. Fortunately for 48K Spectrum owners, the team at Melbourne House have managed it, and in pretty good style too.

You may wonder how it could have taken 18 months, when the Spectrum has been available for less than a year. The answer is that the program was originally being developed on a TRS-80, but was converted to the Spectrum in order to make use of high resolution colour graphics. The plot of the adventure has been designed to follow the original book as closely as possible, in fact to such an extent that a copy of the book is supplied with the program in order to provide additional clues. Also part of the package is a 16 page book of instructions, although if you find the prospect of digesting them not to your liking, there's nothing to stop you rushing headlong into the enterprise. After all, that's what Bilbo did! The instruction book is well-structured and clearly laid out, although disappointingly lacking in hints!

Enter the dragon

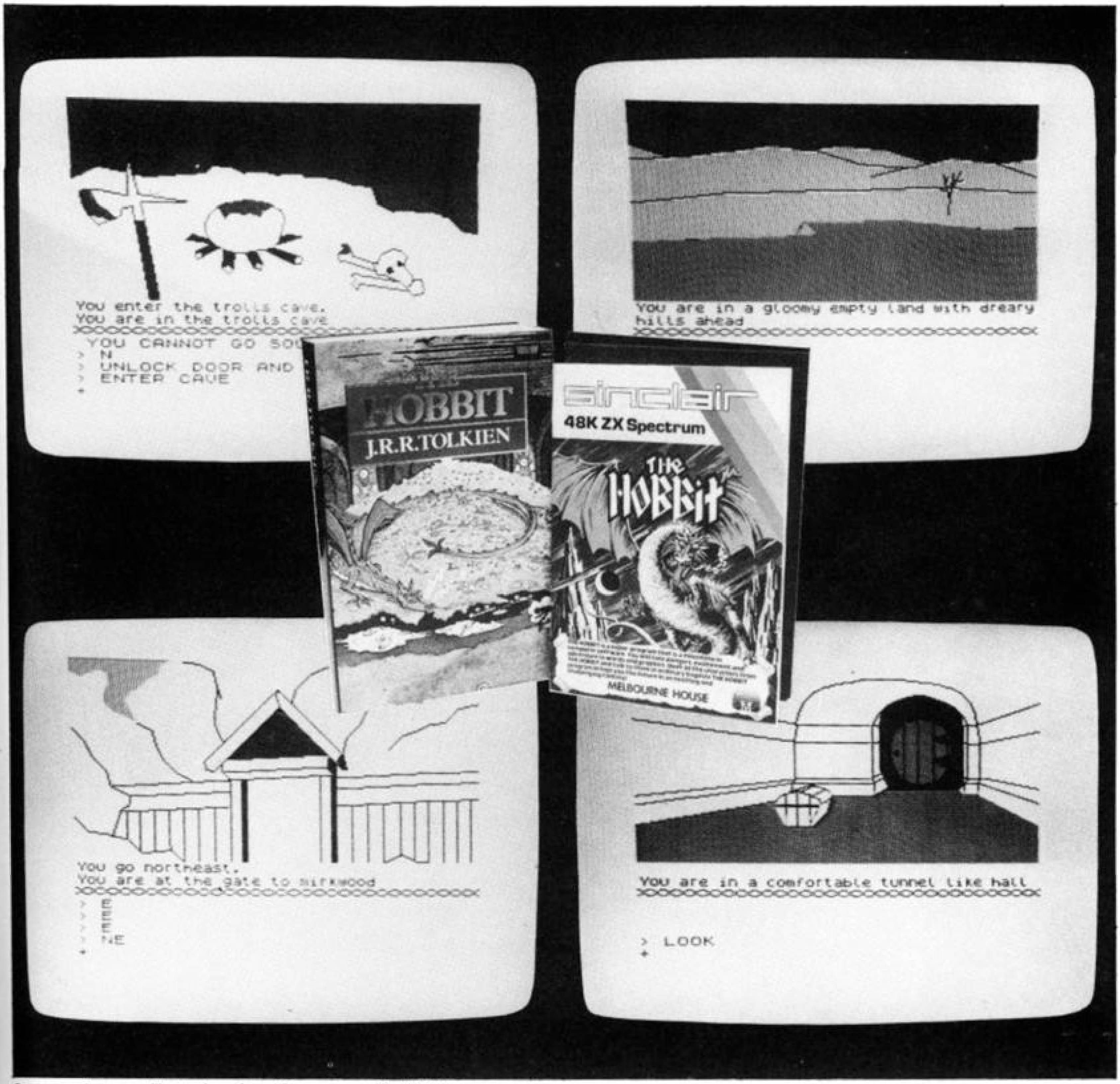
The game is set in Middle Earth during its Third Age, when it was inhabited by all manner of creatures, long before the world was overrun by Man. You take the role of Bilbo, the hobbit of the title, and your task is to steal treasure from a dragon, 'a most specially greedy, strong and wicked worm called Smaug'. In the book, Bilbo has 13 dwarves to help him get there and (hopefully) back again, but in the program you have just one companion, Thorin Oakenshield. He is an 'enormously important dwarf' not least because we are warned that if he gets killed, Bilbo is most unlikely to survive. Along the way you will meet elves, wolves and orcs as well as the famous wizard, Gandalf the Grey, who is usually not far away.

The program is written in 40K of machine code and data, so it takes about four minutes to load. While you are waiting, you have an impressive picture to look at of Smaug and the Lonely Mountain which contains his lair. The program starts by drawing a colour picture of Bilbo's nice bright hobbit-hole, complete with round green door and wooden chest waiting to be filled with dragon's plunder.

The use of graphics is one of the features which makes The Hobbit special. The adventure contains something like 80 locations, of which no less than 30 are illustrated. The graphics are based on drawings commissioned from the artist Kent Rees, and while none of them are quite as elaborate as the picture of Smaug, they do contain a remarkable amount of detail. By using special techniques, each picture is stored in only 3,000-4,000 bytes. The outline is drawn very quickly, but the filling in with colour is done line by line and so does take a few seconds. It can be slightly tedious when the same picture keeps being re-drawn, but this is only a minor drawback as the addition of graphics as



Photograph courtesy of United Artists



Some sample screen illustrations from the program, The Hobbit.

good as these adds a whole new dimension to the adventure.

Picture this

Once you have admired the pretty picture, pressing any key gives the written description of the location. This also has some special features. Firstly, the screen is split into two 'windows', the top 17 lines being used for the illustrations, the narrative descriptions and responses from the various characters. This is in upper and lower case, and by redefining the character set, the output is displayed with 42 characters per line. The bottom 5 lines make up the 'communication window' in which you type your commands and if the computer doesn't understand or cannot carry out your request, a message is displayed here. The lower display is made up of standard 32 characters per line capitals. Some keys have special meanings — '?' means repeat the command, 5, 6, 7 and 8 can be used to move West, South, North and East, 0 deletes the last character entered and Shift 0 deletes the whole line.

Commands are entered using what the authors have named Inglish, which they claim is the most sophisticated natural language recognition program yet developed on any micro. You can enter quite long sentences, such as 'Attack the warg carefully with the knife' and 'Pick up the rope and sword'. More than one sentence can even be entered, up to a maximum of 128 characters. The authors claim a vocabulary of more than 500 words, which is extraordinarily large. Yet, despite the size it is very quick, although the system is not perfect. For example 'light' is a command common to many adventures, and is accepted in The Hobbit, although nothing happens and the curious message 'You light' is displayed. Similarly, if you attempt to cross the enchanted river by saying 'Cross', the program says 'You cross', but when you look around you find that you are, in fact, still stuck on the original side.

Cries for help...

Several special commands are also available. 'Print' copies everything in the upper, narrative window to the printer. The graphics displays are not copied, which is perhaps just as well as it would slow down the game if they were, and also the black and white result wouldn't do justice to the colourful designs. Your commands are ▶



Photograph courtesy of United Artists.

not sent to the printer, so you cannot necessarily use the output to follow an earlier path. Still, Bilbo is meant to be fond of making and reading maps! 'Noprint' turns the printer off. 'Save' saves your current position on tape; just the necessary data is saved, so it only takes 30 seconds. The program doesn't use the standard ROM routine, and I found that the tape position was important as starting too early gave a tape loading error. The data saved can also be verified before continuing, and is reentered with 'Load'.

'Score' tells you how far into the adventure you have delved, based on the percentage of the locations you have discovered. I never managed to get very far at all before a troll, warg, or some other unidentified creature drastically rewrote the book by killing me off and sending me back to the start. 'Help' is a very useful command, and will quite often give a hint as to the way out of your latest predicament.

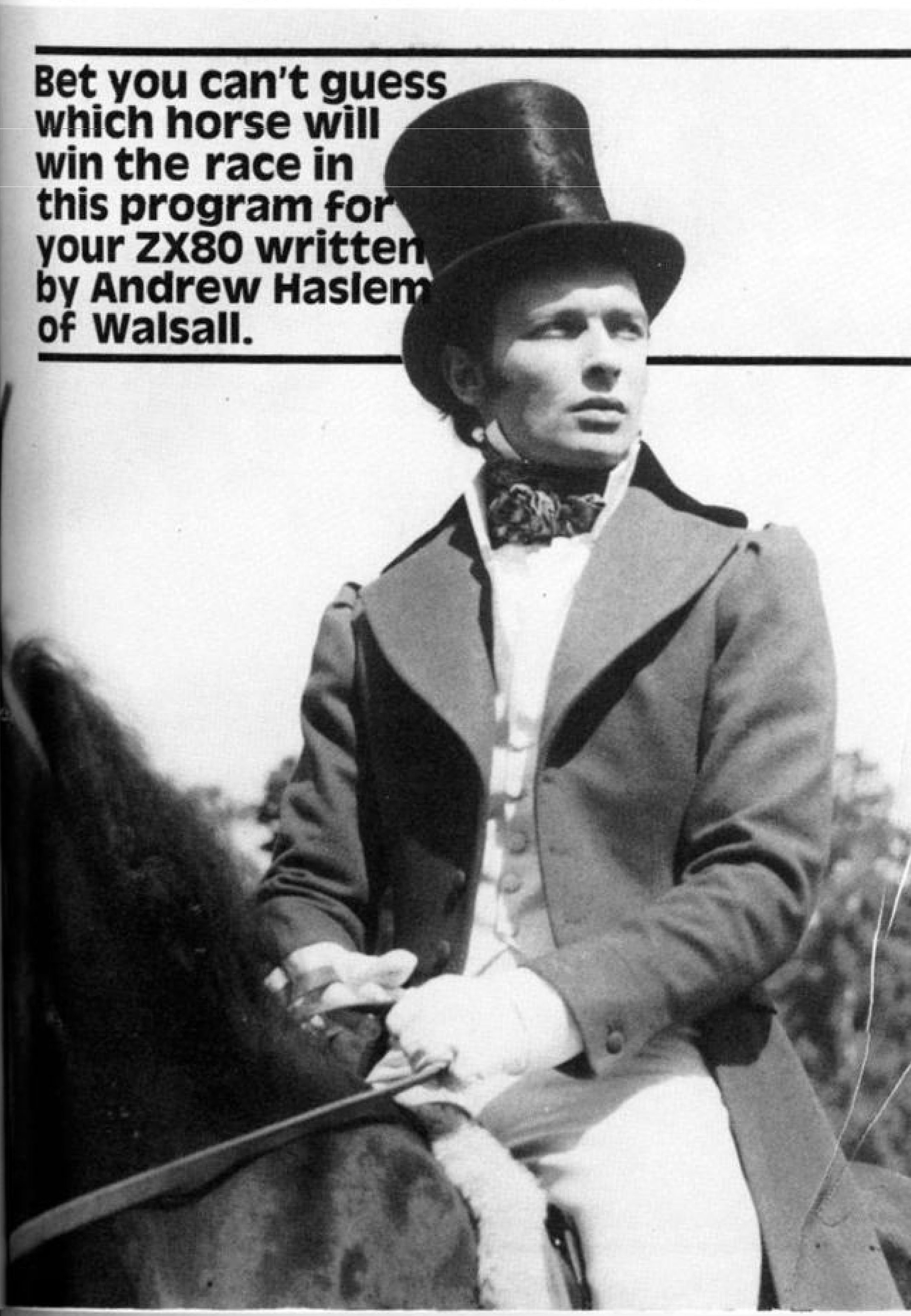
Two other features of The Hobbit that the authors are very proud of are 'Animtalk' and 'Animaction'. The first allows you to speak to anyone present so, for example, you can enter 'Say to Thorin "examine the map"', and he will either respond or say 'No', depending on his mood. 'Animaction' refers to the fact that all the animals and individuals have an independent character and will be moving around and making decisions on their own, without waiting for you to do anything. So far about the only animaction I have witnessed is Gandalf behaving uncharacteristically indecisively, by continually giving and then taking back a curious map. Also, Thorin seems to either wait, enter, say 'Hurry up' or start singing about gold, apparently at random.

A wizard game

Despite having only explored little more than an eighth of 'Wilderland', I have seen nine graphic locations and picked up which I assume will have some purpose. I haven't yet found a way into the roots of the Misty Mountains, but I hope I will as I greatly look forward to the riddle contest with Gollum (incidentally the riddles are different to the ones in the book, not surprisingly!). At a couple of recent micro exhibitions I have noticed that the staff on the Sinclair stand (when not selling hundreds of Spectrums) have been deeply engrossed in playing The Hobbit rather than any of the dozens of other programs available on their stand. The fact that they had neither solved nor tired of this program says quite a lot! It is certainly a marvellous game, which should set the standard for future Spectrum adventures. However, in spite of the excellent graphics and packaging, I feel that £14.95 is a rather high price for a program which is clearly going to sell many thousands of copies.

The Hobbit is available from Melbourne House, 131 Trafalgar Road, London SE10 and branches of WH Smith.

Horsing about



Bet you can't guess which horse will win the race in this program for your ZX80 written by Andrew Haslem of Walsall.

You begin this game with £100 in your pocket, and each time you make a bet on a horse, your stake money is set at £10. If your horse is not first past the post, you lose your money. However, if you're lucky and your choice wins, you will be credited with a random amount up to £50.

Should you run out of cash, the game will halt and you will be told how many races you bet on. The program will also ask you if you would like to have another game.

For some idea of how many races you can bet on, Andrew managed 60 races before he ran out of cash. Can you do better?

```
30  LET K=0
40  PRINT "HORSING
    ABOUT"
50  PRINT
    "-------------
    --------"
60  FOR I=1 TO 5
70  PRINT
80  NEXT I
90  LET M=100
100 PRINT "HIT N/L TO
    PROCEED"
110 LET K=K+1
120 INPUT A$
130 CLS
140 IF M < 10 THEN GO
    TO 320
150 LET Z=RND(6)
160 PRINT "WHICH HORSE
    DO YOU WANT TO
    BET ON (1 TO 6)"
170 PRINT "YOU HAVE
    £";M
180 INPUT S
190 IF S=1 AND Z=1
    THEN GO TO 270
200 IF S=2 AND Z=2
    THEN GO TO 270
210 IF S=3 AND Z=3
    THEN GO TO 270
220 IF S=4 AND Z=4
    THEN GO TO 270
230 IF S=5 AND Z=5
    THEN GO TO 270
240 IF S=6 AND Z=6
    THEN GO TO 270
250 LET M=M-10
260 GO TO 100
270 PRINT "YOU WON"
280 LET G=RND(50)
290 LET M=M+G
300 PRINT YOU HAVE
    £";M
310 GO TO 100
320 PRINT "YOU HAVE NO
    MORE MONEY"
330 PRINT "YOU HAVE
    LOST IN ";K;" BETS"
340 PRINT "AGAIN?"
350 INPUT A$
360 CLS
370 IF A$="YES" THEN
    GO TO 10
380 STOP
```

Photograph courtesy of Transcontinental Film Productions (London) Ltd.

Photograph courtesy of United Artists.

Competition
Competition
Competition

Win a complete library for your ZX Spectrum.

Thinking caps off, it's time to relax and enjoy this easy-to-enter competition in which you could win a complete library of books for your ZX Spectrum.

No doubt, you've all seen wordsquares before, but for the sake of anyone who has not, all you have to do is to find the missing words in amongst the jumble of letters. Sounds easy... until you try it that is! The words hidden in this wordsquare are the names of the authors (and editor) of the books to be given away as the prize.

Once you have found the missing names, draw a circle around them and fill in the form below with your name and address. Before you package the letter off to the address given, please count the number of shared letters, ie a letter which appears in at least two names, and write this number on the back of the envelope.

The winner of the competition will be the first correctly completed wordsquare picked at random from a hat.

The prize

The winner will receive the following titles to add to their library:

Spectrum Machine Language For The Absolute Beginner... Edited by William Tang.
Games ZX Computers Play... Tim Hartnell.
The Spectrum Pocket Book... Trevor Toms.
Games To Play On Your Spectrum... Martin Wren-Hilton.
Programming Your ZX Spectrum... Tim Hartnell and Dilwyn Jones.
The Spectrum Programmer... S M Gee.
Learning To Use The ZX Spectrum Computer... Robin Bradbeer.
Understanding Your Spectrum... Dr Ian Logan.
60 Games And Applications For The ZX Spectrum... David Harwood.
The Spectrum Handbook... Tim Langdell.
Exploring Spectrum BASIC... Mike Lord.
The ZX Spectrum Explored... Tim Hartnell.

Rules

This competition is open to all UK and Northern Ireland readers of ZX Computing except employees of Argus Specialist Publications Ltd, their printers and distributors, employees of the publishers of the books to be awarded as the prize, or anyone else associated with the competition.
As long as the correct coupon is used for each entry, there is no limit to the number of entries.
All entries must have the number of shared letters written on the outer flap of the envelope. Entries without this number will not be accepted.
All entries must be postmarked before May 31, 1983.
The prize will be awarded to the first correct entry picked at random.
No correspondence will be entered into with regard to the results and it is a condition of entry that the Deputy Editor's decision is accepted as final.
The winner will be notified by post and the results will be published in a future issue of ZX Computing.

Address your answers to:
ZX Competition,
145 Charing Cross Road,
London WC2H 0EE.

A	Z	R	N	A	G	O	L	N	A	I	R	D	R
E	M	T	L	T	R	E	V	O	R	T	O	M	S
T	A	O	T	M	S	A	N	S	R	O	B	S	T
O	R	L	L	E	D	G	N	A	L	M	I	T	V
S	T	G	E	T	M	P	O	T	N	L	N	O	S
N	I	S	N	R	S	E	Y	T	S	K	B	N	Y
L	N	E	V	A	M	I	K	E	L	O	R	D	E
A	W	N	A	G	T	L	A	U	R	A	A	M	R
R	R	O	H	L	R	M	D	R	C	N	D	T	W
E	E	J	A	Y	J	W	A	O	T	I	B	L	A
O	N	N	M	S	H	L	T	I	X	V	E	P	T
W	H	Y	W	M	O	H	C	R	L	G	E	O	S
S	I	W	S	G	R	K	L	S	A	L	R	S	R
D	L	L	L	E	N	T	R	A	H	M	I	T	V
A	T	I	C	E	S	T	R	E	U	P	N	W	A
V	O	D	O	O	W	R	A	H	D	I	V	A	D
K	N	L	S	E	A	O	M	L	Z	T	S	T	T

ZX COMPUTING COMPETITION

Name . . . .

Address . . . .

. . . .

. . . . Postcode . . . .

Into the fourth dimension

A review of the new 4-D adventure from Quicksilva, with Phil Garratt at the helm.



Three dimensions were not enough for the latest addition to Quicksilva's long line of machine code arcade games. Time-Gate involves travelling backwards through the fourth dimension, time itself. We are told that the two thousand year old interstellar Empire founded by Earth was happily going the way of all empires, that is into decline, when the Squarm turned up. They are a race of insectoid reptiles, and before long they had taken over the entire Empire, except for a few planets centred on the Earth.

The Temporal Brotherhod decide to overthrow the Squarm, but instead of doing the decent thing and fighting it out man to man (or rather man to reptile), they hit on a sneaky trick. They dig out the two thousand year old Void-Runner 1, a trans-dimensional space ship, and give you the mission of travelling back through time via the Time-Gate until you can destroy the Squarm's home planet before they ever left it.

The Empire strikes back

The galaxy is made up of 18 sectors, one of which contains the Time-Gate which your ship will automatically pass through provided there are no enemy ships in the sector. Knocking out the enemy ships is the central part of the game which all the rest has been tacked onto. The top two thirds of the TV display are used for the three-dimensional view of space, and as you steer your craft, the stars swirl round according to your movement.

When ships appear they weave in every direction, diving nearer and further away, all the time firing pot shots at you. You have to manoeuvre your craft until the enemy is in line with your two lasers, which fire from either side converging into the centre. I found it best to try to line up the alien along one or other of the beams rather than try to hit it at the narrow point where the beams meet. Unless you get a lucky shot, it will usually take four hits to knock out the opposition, and you can tell when a hit has registered because the enemy ship changes colour.

An unusual arrangement of keys are used for movement — 6 and 7 for left and right, 8 and 9 for up and down. Zero fires the lasers. The program comes with a little keyboard overlay to help you remember them, but before long the keys are memorised and then the overlay tends to get in the way rather than help.

The bottom third of the TV display is your instrument panel. To the left is the long range scanner which shows all 18 sectors. Alien ships are marked as a short line, and a planet, where you can have repairs done, is shown as a cross. The display is very small indeed, and some people with ropey TVs (or eyesight!) may have some difficulty. In the centre of the console display is the message system, which flashes up details about damage sustained and other information as the game progresses. To the right is the target computer display, which consists of four horizontal lines each with a marker on it and is only active when there are enemy ships in the area. The first two lines are the vertical and horizontal tracking indicators and when you have steered Void-Runner 1 so that the markers are in the middle, you are right behind the 'baddie'. The third indicator gives the closing speed and the fourth, the distance between you and the target. The enemy are scattered randomly within the sector, and you can have quite a long wait before they appear on the upper display.

Set the controls...

The last console instruments are the status indicators for shields, weapons, engines, etc. They start off green and go steadily darker as the systems are damaged, until they turn blue which means that that function is knocked out. When you take a hit, the damage seems to be allocated randomly to one of the various systems, so if you're unlucky all the damage may be done to just one system, and if it takes another hit after the indicator has turned blue, your ship is destroyed.

The rest of the control keys are as follows — 1 to 5 control your warp speed, and you can tell when you go faster because the stars rush by, and the engines, which make a constant hissing sound, go to a higher pitch. To jump to a different sector, you press 'L' until the flashing indicator on the long range scanner is over the sector you require, and then press 'J'. You then make your jump, accompanied by some impressive sound and visual effects. To carry out repairs, you have to jump to a sector with a planet and knock out any aliens. Then pressing 'P' causes a landing, also accompanied by very ingenious graphics. All your systems are then restored to 'green' status; however, this does result in the unfortunate planet's destruction. Perhaps they would have been better off under the Squarm! 'H' suspends the game and 'S' restarts it, and 'Shift Space' aborts the current run.

The game progresses by knocking out as many aliens as possible, finding the Time-Gates, stepping back through time to year zero, then finding the Squarm home planet and firing your Meson Ram to destroy it. The game can be played on 5 levels, and at the higher levels the time steps get smaller, and as each earlier galaxy has more and more aliens, the game gets progressively harder.

Is that all!!

The biggest fault with Time-Gate is undoubtedly the scoring system. Several times I battled my way through hordes of aliens, eventually to destroy the Squarm home base, to find I had scored between 10 and 40 points! I queried this with Quicksilva, and they said that the score is based more on your skill factor, ie how quickly and efficiently you knock out the aliens, rather than how many. I was told that the best tactics were to stay at warp 1 (the slowest) while in a sector chasing and fighting aliens, only using warp 5 for the jump to the next sector, and putting off repairs for as long as possible.

The program comes in two 34K parts. The first gives you the scenario and rules, and goes through the cockpit display and function keys. The program has provision for the use of a Kempston joystick, and has information about how to link in other makes. The second lot of 34K is the program proper. The documentation is rather lacking — you have to note down the control keys yourself, no information is given about scoring, and nowhere is it mentioned that you can LOAD the second part (the game proper) without going through the instructions. Still, graphics are what arcade games are all about, and Time-Gate certainly has great graphics. At £6.95 (48K Spectrum only), another winner for Quicksilva.

Time-gave is available from Quicksilva, 92 Northam Road, Southampton, Hants SO2 OPB.

Adding interest to your programs — part one

In this two-part feature, Tim Hartnell describes the genesis of a simple idea for a program through to a full-blown, arcade-style game on your ZX Spectrum.

Once you've been using your Spectrum for a while, you may find that while it is relatively easy to get some sort of program up and running, it is not so simple to turn that program into something you'd be proud to show your friends. In this article (to be continued in the next issue of *ZX Computing*), I'll explain how a simple framework can be 'dressed up' with sound, colour and user-defined graphics.

Out for a duck

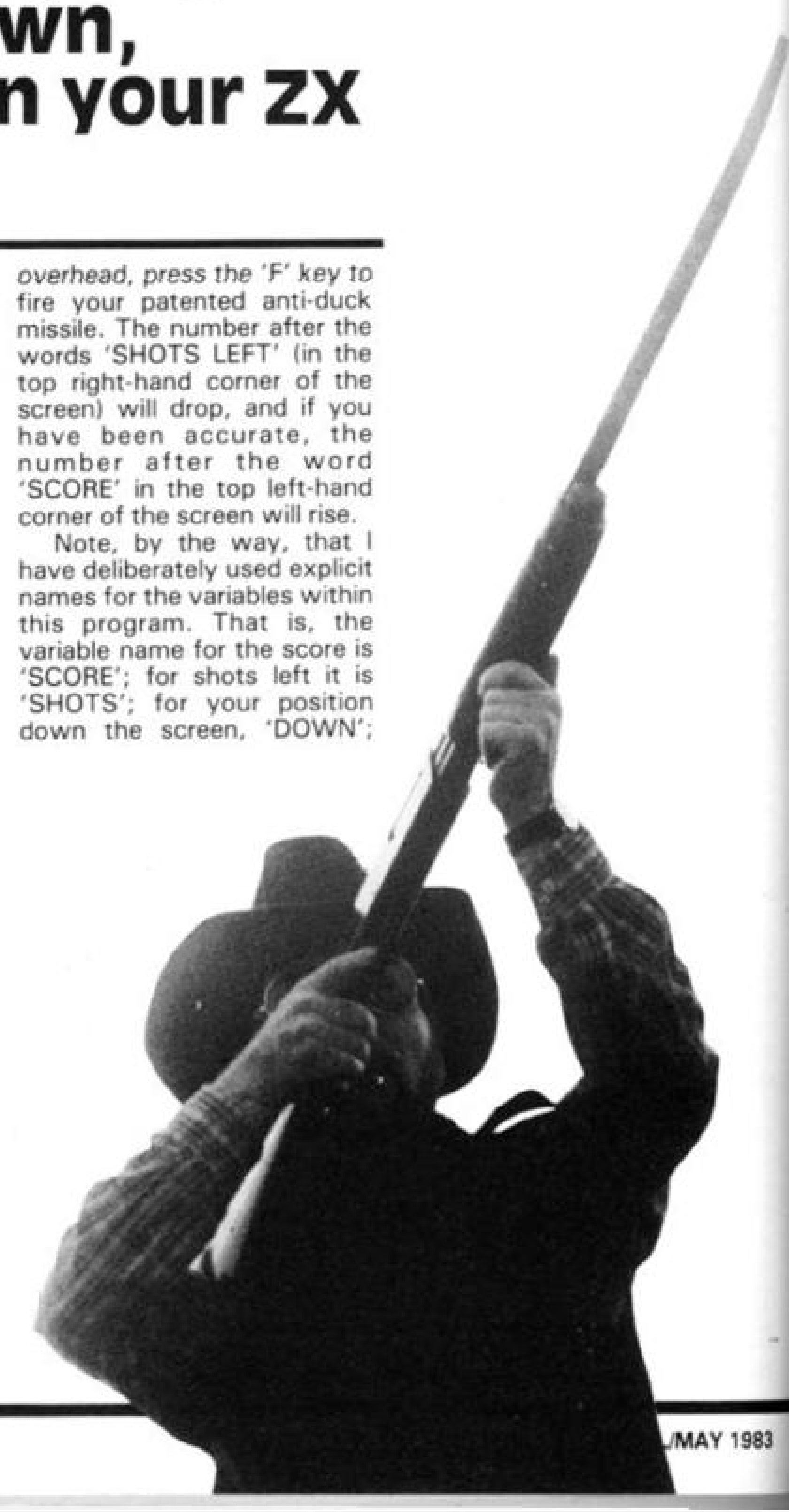
We're going to take a simple program — Duck shoot — and gradually elaborate it, showing how adding things such as sound and colour, border flashes and user-defined graphics can add a great deal of interest to your programs. At the end of this two-part feature, I'll give you four more suggestions to apply if you wish to keep improving and elaborating the program I am going outline.

The program we're going to use as the core of our development work is a fairly standard 'Duck shoot' listing, in which little objects fly across the screen, and you have to try and shoot them down. In the first version of the program, the little objects are letters chosen at random and you are the letter 'X'. You fire at the 'ducks' by *pressing the 'F' key and you* move yourself left using the '5' key and right using the '8' key (moving in the direction of the arrows on those keys).

Although there is no time limit on this program (so, you don't have to shoot the ducks in a specified time) there is a limit on the number of shots you can fire. In all the versions of this game in this part of the article, you'll see the program starts with a limit of 15 shots. In the last, most complex version, you will have 50 shots. The number of shots is deliberately kept low in the first version, so you are not able to get a high score just by leaving your finger on the 'F' key and waiting for the ducks to fly into the line of fire. Look now at Program 1. Type it carefully into your Spectrum and type RUN, then press Enter and you should get the game underway.

You'll see the letters which are held in A$ (see line 40) moving across near the top of the screen. You (the 'X') will be in about the middle of the screen when the program starts. You can, as I mentioned a few moments ago, move yourself back and forth using the '5' and '8' keys to get yourself into the position which you think gives you the best possible chance. When you judge a 'duck' is directly *overhead, press the 'F' key to* fire your patented anti-duck missile. The number after the words 'SHOTS LEFT' (in the top right-hand corner of the screen) will drop, and if you have been accurate, the number after the word 'SCORE' in the top left-hand corner of the screen will rise.

Note, by the way, that I have deliberately used explicit names for the variables within this program. That is, the variable name for the score is 'SCORE'; for shots left it is 'SHOTS'; for your position down the screen, 'DOWN';



and for your position across the screen, the variable name is 'ACROSS'. Even though it takes a little longer to type long variable names into a program and (of course) they use up more memory than do shorter names, running out of memory is rarely a problem on the ZX Spectrum, and the advantages of using explicit names to keep the purpose of various parts of the listing clear way outweighs the extra time it takes to type them in. If, for example, you were writing a program like this and you decided that it would be better if the 'X' was printed slightly further down the screen, you would not have to search through the program to work out which variable held your 'down' co-ordinate. If you have used explicit names as in this case, you would find it very easy to locate the variable you were looking for.

Disappearing ducks?

RUN the program a few times, then return to this magazine for the first part of our discussion on it. Note the Caps Lock must be engaged, as INKEY$ is searching for an input of a capital 'F' to fire.

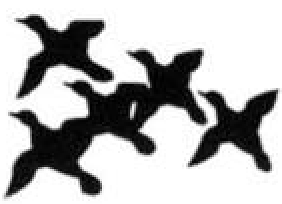
Line 40 defines the string variable, A$, as a long series of letters and spaces. The letters can be anything you like; don't feel you need to copy mine. The important thing, however, is that the string is 32 characters long. You can check this by RUNning the program briefly, stopping it with Break, then typing in as a direct command:

PRINT LEN A$

(you'll find LEN in green above the K key, and — as you know – you get the words above the keys by pressing down both Caps Shift and Symbol Shift at once, then touching the key). If your string is the correct length, PRINT LEN A$, followed by Enter will give you the answer 32.

The appearance of movement which is given to the ducks is created by use of Sinclair BASIC's string-handling commands, which allow for a technique called 'slicing'. The vital line for the movement is line 130, which resets A$ equal to all of the string without its first character – that is, LET A$ = A$(2 TO) – and then adds to the very end of it the character of the string which was at the beginning, A$(1). The string is reprinted, over and over again, as the program RUNs by line 70) in the same position at 7,0 (eight lines down and starting hard in the left-hand margin). Because the string is, in effect, being 'shifted along' one character at a time before it is re-printed, the elements in the string appear to move smoothly along. Using strings in this way is one of the simplest ways there is to create smoothly moving graphics on the Spectrum.

The string handling also makes it very simple to cause the shot duck to disappear from the sky. As the string is 32 characters long, each character 'slot' can be reffered to by following A$ with a number in brackets. That is, A$(1) is the first element of the string, A$(2) is the second one, and so on, until A$ (32) is the very last spot within the string.



Look at line 90. When the computer comes across an IF/THEN statement, it checks to see if it finds that it is *not* true, then it moves along to the next line in the program, without bothering to carry out any further instructions which may be on the same line. If the computer finds, at the start of line 90, that INKEY$ does not equal 'F' (that is, you are not pressing the 'F' key) then it proceeds to line 100, missing all the information and instructions which follow the IF INKEY$ = "F" line. If, however, you *are* pressing 'F' when the Spectrum gets to line 90, it continues working through the line and decrements the variable, SHOTS, by one. Then, it hits another IF/THEN condition, which makes use of the ability of the Sinclair BASIC to isolate any element of a string instantly. It looks as A$(ACROSS). The 'X' which is you is printed at ACROSS (actually, as you see in line 80, a three-element string, with a space either side of the 'X', is printed at ACROSS minus one, which has the effect of printing the 'X' at the position referred to by the variable ACROSS, so A$(ACROSS) lies directly above you.

If line 90 discovers that A$(ACROSS) is anything but a space, you have hit a duck, so the computer continues working through the line. The variable, SCORE, is incrementd by 57, and finally in line 90, that element of A$ is set to a blank, so the 'duck' disappears.

Now all this takes some time to explain, but you'll find the computer does it apparently instantaneously. You press 'F', the score increases by 57 (if you're a good shot), the number of shots left drops by one, and the duck disappears. You'll see (line 110) that the program continues until you run out of shots; the game then terminates. Take a note of your score at this point, and see if you can beat it in subsequent runs.

'A l'orange?

Once you have this program running to your satisfaction, and you have a pretty good idea of how it works, modify it to read like Program 2. (You do not have to NEW the computer). Just compare the program you have in your Spectrum, line by line, with the listing of Program 2 and make any changes you need to (adding a complete new line 15, and modifying certain others).

When you RUN this, you'll see an immediate and quite striking improvement. Colour certainly adds a lot to any program on the Spectrum. Line 15 sets the PAPER (that is, the background) colour to white (PAPER colour 7); turns the BRIGHT control (which affects, in this case, the entire screen); clears the screen so that the PAPER and BRIGHT are activated (you could not see them over all the screen unless you had included the CLS command); and finally, sets the INK colour (the colour in which the computer prints on the PAPER) to red (INK colour 2).

Even if we did not take the program any further, we would still have a significant improvement on the first version. You would have the score, shots left, ducks and the 'X' all printed in red on a bright white background, which is far more interesting than just plain old black and white.

However, we want to add two more commands to the program which will alter the display for the better. These are in lines 70 and 100. In line 70, the 'INK RND*6' is used to choose a colour at random between black and yellow, so that each time A$ (the ducks) is reprinted, it will occur in a different colour! As you'll see when the program is RUNning, the change occurs so rapidly the ducks appear to shimmer. Though it takes the Spectrum an appreciable number of nanoseconds to generate a random number, the effect on the speed of the program appears to be nil. (You are probably aware that, in moving graphics programs, everything you get the computer to do — from making an IF/THEN decision, adding two numbers together, or raising one to the power of the other, to generating a random number — takes time, and the more you get the computer to do before each subsequent frame of a moving graphics program is printed, the more slowly the graphics will move, and the more jerky they will appear.)

The last change we've made is in line 100, where FLASH is used to make sure the actual number of the score, and the number of shots left, flash off and on, but the rest of the line does not. This is why there are so many FLASH 0 and FLASH 1 commands in that line. Leave any one of them out and the effect is ruined, as you can easily see by deleting one of them and re-RUNning the program.

Looping the loop

Apart from the colour changes we've discussed, the program is the same as the first listing. However, you can see that the few changes we have introduced have improved it considerably. We'll now continue with the improvements, by adding some sound, and getting the BORDER (the area around the picture, or PAPER, area) to flash when a duck is shot.

Enter Program 3, RUN it to decimate a few flocks of ducks, then return to the magazine for a discussion on the program.

The new lines are 25 and 35 which use the BEEP command to create two 'loops' of sound before the program gets underway. As you know, the BEEP command has two parameters (and parameters are the numbers, or 'arguments' which follow a command to set its limits). The first number after BEEP defines the duration of the sound, and the second one its pitch.

Line 25 is a loop, using 'G' as the control variable. The loop runs from one to 20, and each value of G is used in the second part of line 25 to create a tone, which — because G is increasing — rises rapidly. The duration parameter is set at .008 which is about the shortest sound I've found can be heard clearly. Line 35 produces another loop, this time counting downwards. You'll discover that different STEP sizes produce quite different types of loop effects, and you may well wish to change the STEP size in both this line and in line 25.



These two loops, however, are little more than 'window dressing', designed to produce a good starting effect. The other BEEPs used, by contrast, are related to other things happening within the program when it is RUNning. You'll see that a BEEP line has been added at the end of line 70. This takes the CODE (the number which the computer uses to refer to the character being printed, so PRINT CHR$ 65 produces the letter 'A', whose CODE is 65) of the *first element* of the string A$ (that is the element which is the furthest to the left) and creates a tone from this. The effect of this is to produce a short 'beep' just before a duck disappears off the screen to the left.

You'll see another BEEP command at the end of line 80. This one is sounded every time the program cycles and, because as the variable ACROSS gets bigger the pitch of the note gets higher, you'll find that moving your 'X' across the screen to the right will produce a constantly higher tone; moving it to the left will lower the tone.

Trigger happy

Perhaps the most interesting sounds are in line 90. Firstly, you get a BEEP, which is related to the number of shots you have left, every time you touch 'F', whether you hit anything or not. RUN the program and hold your finger on 'F' — you'll hear the tone steadily decrease till the 'THAT'S THE END OF THE GAME' message appears.

The next part of line 90, as you know, checks to see if your shot has hit anything (that is, it checks to see if that particular element of the string A$ is *not* equal to a space), and if it finds that it is not a space (that is, that a 'duck' is there and had just that instant been shot), the computer — as well as increasing your score by 57 — BEEPs again, with a tone which, although different to the first one in the line, is related to the number of shots left. This means that if you have a successful shot, you'll hear first the tone (which falls with each shot fired) from the first part of line 90, followed by a tone (which rises as the SHOTS variable is decremented) which signals that a duck has been shot. And if you're not quick in taking your finger off the 'trigger', you'll hear a third one, or even more.

The final part of line 90, which changes the BORDER colour four times, is — of course — only triggered if you've downed a duck. It has the effect of the BORDER flashing very quickly in randomly chosen colours, then reverting to white. The delay caused by including this flash is very short, and gives good visual feedback to back up the feedback from the BEEP to tell you that you've bagged another duck.

What's for seconds?

In the second part of this feature, I will be introducing the concept of the user-defined graphic and how to simply incorporate them into your programs.

I will be introducing two new and updated versions of the Duck shoot program, which will include user-defined graphics as well as more than one line of ducks! Join me next issue . . .

Program 1

```
  10 REM DUCK SHOOT
  20 LET SCORE=0
  30 LET SHOTS=15
  40 LET A$="ZAB  DK SL DF G
FD FGG   G   "
  50 LET ACROSS=15
  60 LET DOWN=14
  70 PRINT AT 7,0;A$
  80 PRINT AT DOWN,ACROSS-1;" X
"
  90 IF INKEY$="F" THEN LET SHOT
S=SHOTS-1: IF A$(ACROSS)<>" " TH
EN LET SCORE=SCORE+57: LET A$(AC
ROSS)=" "
 100 PRINT AT 0,0;"SCORE:  ";SCOR
E,"SHOTS LEFT:  ";SHOTS;"   "
 110 IF SHOTS<1 THEN PRINT AT 10
,0;"    THAT'S THE END OF THE GAM
E": STOP
 120 LET ACROSS=ACROSS+(INKEY$="
8")-(INKEY$="5")
 130 LET A$=A$(2 TO )+A$(1)
 140 GO TO 70
```

Program 2

```
  10 REM DUCK SHOOT
  15 PAPER 7: BRIGHT 1: CLS : IN
K 2
  20 LET SCORE=0
  30 LET SHOTS=15
  40 LET A$="ZAB  DK SL DF G
FD FGG   G   "
  50 LET ACROSS=15
  60 LET DOWN=14
  70 PRINT AT 7,0; INK RND*6;A$
  80 PRINT AT DOWN,ACROSS-1; INK
 2;" X "
  90 IF INKEY$="F" THEN LET SHOT
S=SHOTS-1: IF A$(ACROSS)<>" " TH
EN LET SCORE=SCORE+57: LET A$(AC
ROSS)=" "
 100 PRINT AT 0,0; INVERSE 1;"SC
ORE:  "; FLASH 1;SCORE; FLASH 0,"
SHOTS LEFT:  "; FLASH 1;SHOTS; FL
ASH 0;"   "
 110 IF SHOTS<1 THEN PRINT AT 10
,0;"    THAT'S THE END OF THE GAM
E": STOP
 120 LET ACROSS=ACROSS+(INKEY$="
8")-(INKEY$="5")
 130 LET A$=A$(2 TO )+A$(1)
 140 GO TO 70
```

Program 3

```
  10 REM DUCK SHOOT
  15 PAPER 7: BRIGHT 1: CLS : IN
K 2
  20 LET SCORE=0
  25 FOR G=1 TO 20: BEEP .008,G:
 NEXT G
  30 LET SHOTS=15
  35 FOR G=50 TO 20 STEP -2: BEE
P .008,G: NEXT G
  40 LET A$="ZAB  DK SL DF G
FD FGG   G   "
  50 LET ACROSS=15
  60 LET DOWN=14
  70 PRINT AT 7,0; INK RND*6;A$:
 BEEP .008,(CODE A$)/2
  80 PRINT AT DOWN,ACROSS-1; INK
 2;" X ": BEEP .008,ACROSS
  90 IF INKEY$="F" THEN LET SHOT
S=SHOTS-1: BEEP .05,3*SHOTS: IF
A$(ACROSS)<>" " THEN LET SCORE=S
CORE+57: BEEP .05,50-SHOTS: LET
A$(ACROSS)=" ": BORDER RND*7: BO
RDER RND*7: BORDER RND*7: BORDER
 7
 100 PRINT AT 0,0; INVERSE 1;"SC
ORE:  "; FLASH 1;SCORE; FLASH 0,"
SHOTS LEFT:  "; FLASH 1;SHOTS; FL
ASH 0;"   "
 110 IF SHOTS<1 THEN PRINT AT 10
,0;"    THAT'S THE END OF THE GAM
E": STOP
 120 LET ACROSS=ACROSS+(INKEY$="
8")-(INKEY$="5")
 130 LET A$=A$(2 TO )+A$(1)
 140 GO TO 70
```

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Spectramon — part one

Simon Goodwin of Hereford unveils an excellent program for the 48K Spectrum.

SEE 'LETTERS' OCT/NOV 82



If you've ever wondered how your ZX Spectrum works, Spectramon (the Spectrum monitor) will make it easy for you to find out. This program will print or display the contents of ROM or RAM in numeric, character or assembly language form. Addresses may be entered in decimal or hexadecimal, and the user may select the base used for output.

Spectramon will run on a 48K Spectrum with or without a printer. The disassembler option has been written with the failings of ZX80 and ZX81 programs in mind — unlike other published listings it will handle all 694 standard Z80 instruction codes, using the standard mnemonic names and formats devised by Zilog, the firm which designed the Z80 processor used in the Spectrum.

Z80 instructions

The Z80 instruction set is the most complicated of any 8-bit microcomputer. The Z80 processor was designed by a group of people who left Intel, the firm which makes the 8080 processor, to set up Zilog. The Z80 will execute any of the instructions of an 8080, plus a large number of extra ones 'tacked on' by Zilog. This approach meant that programs written to run on an 8080 would also run on a Z80 without changes. New programs could then be written using the added facilities of the Z80. That was how many early Z80 programs were produced. The BASIC interpreter used on the TRS-80, for instance, is substantially an 8080 program even though the TRS-80 has a Z80 processor. Only the display and keyboard routines contain Z80 instructions since they were the last to be written.

Sinclair BASIC is written using the full features of the Z80 processor. Zilog added instructions to handle fast moving and searching of tables in memory, extra registers (internal storage) and instructions to icnrease the number of things that could be done with the original 8080 registers. They wanted to more than double the number of possible instructions, but there was a problem — Intel had decided to use a single byte (8 bits) to store the instruction-numbers for the 8080, and most of the 256 possible numbers were already in use.

Zilog got around this by giving four instruction numbers special meanings — instructions with one of those numbers would carry out a certain 'class' of operation, and the next byte would explain the operation required in detail. In theory, that gave Zilog plenty of possible numbers — 252 (using the remaining one-byte values) plus 1,024 (4 * 256) if they were to use all of the possible two-byte instructions. In practice, they only used 694 of the 1,276 possibilities, but that's still a very large number of instructions for an 8-bit computer!

If you consult Fig. 5, you will see the standard Z80 mnemonics listed. The prefix byte 203 is used to generate add-on instructions for 'bitwise' operations — instructions which manipulate or test binary digits. The prefix byte, 221, indicates that the next instruction is an 8080 one, which would use register pair HL but must now use register IX instead. Likewise, the prefix, 253, indicates that IY should replace HL in the next instruction. If HL was in brackets in the old 8080 instruction (as in LD a, (HL)) then the Z80 version allows an offset to be applied to IX or IY before use — this is specified in an extra byte after the end of the 8080 instruction. Finally, the prefix 237 is used to indicate that the instruction following is one of a group of miscellaneous Z80 add-ons.

Monitoring the situation

If all this sounds very complicated you've probably realised why a monitor is a useful program — Spectramon will automatically convert sequences like 'EDH 7BH 3DH 5CH' into the mnemonic, LD SP, (23613). The EDH told Spectramon that it was a miscellaneous Z80 add-on instruction (EDH is 237 decimal). The 7BH corresponds to LD SP, (some address), and the 3DH 5CH corresponds to the value 23613. To check that, convert 3DH and 5CH to decimal then add the first result to the second (multiplied by 256). It's an awful lot simpler to let the computer puzzle that out than it is to work it out for every instruction by hand.

Of course, you may think that LD SP, (23613), is just as baffling as EDH 7BH 3DH 5CH — in which case, you'll have to learn a little about Z80 machine code before Spectramon becomes useful to you. Before you can investigate the ROM of a computer, you do need to understand the computer language in which it was written — assembler, in most cases. LD SP, (23613) is an assembler (or 'assembly language' or 'machine code') command. If

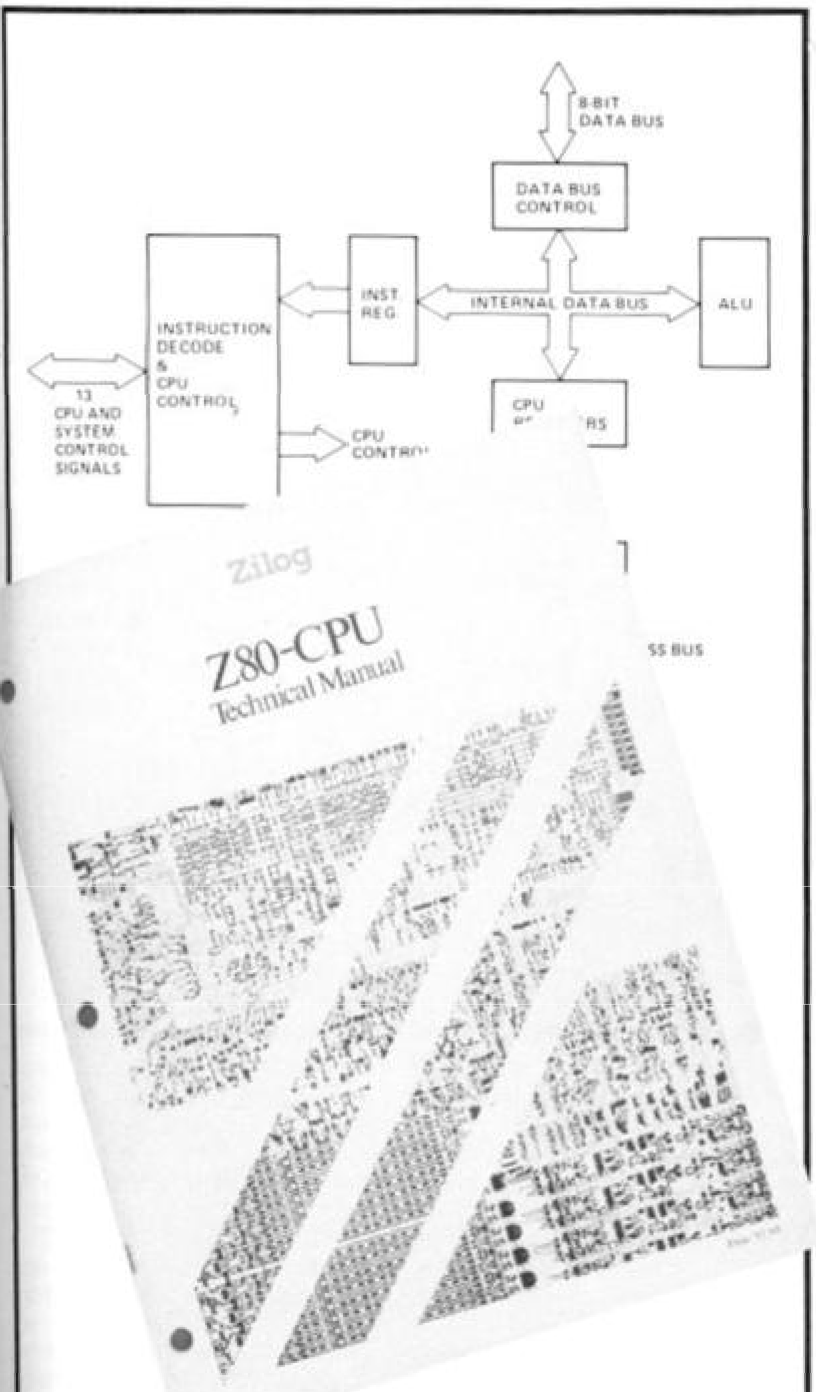
you don't understand assembler, please don't throw this article away! It will take you no longer to learn assembler than it did to learn BASIC (it should be just as much fun too) and you can come back to Spectramon when you know more.

In fact, the instruction LD SP, (23613) has a very simple purpose — it tells the computer to put the number in address 23613 into the register called 'SP'. If you consult the Spectrum manual you will find out that 23613 is the 'address of item on machine stack to be used as error return', which tells you that the instruction is part of the ROM error-handler. Using a disassembled listing and the table of 'System variables' in chapter 25 of the manual, you can trace your way through the ROM, finding out what each section does.

Using the program

Spectramon takes about 15 seconds to set itself up when first RUN. During this time, it is building a table of instruction codes for the disassembler, and once that is complete, the menu of commands will appear. Figure 1 shows this display.

To quit from the monitor, type 'Q' followed by Enter. This returns you to ZX BASIC. If you wish to disassemble a program in RAM or ROM, then you should type 'D' followed immediately by the address at which you want to start. Addresses may be entered to Spectramon in decimal or Hex — if you want to disassemble from address 126 (decimal), you could type D126 or DOO7EH or D7EH — leading zeros are optional — and if you enter more than four Hex digits, only the last four will be con-




```
COMMANDS

Q Return to ZX BASIC.

D<address> Disassemble Program.

N<address> Numeric dump memory

A<address> ASCII mem. display.

P Printer option (now ON)

B Base Selection (now HEX)
```

Fig. 1. The various options offered by Spectramon.

```
007E 21D0FE   LD   HL,FED0H
0081 0D       DEC  C
0082 C8       RET  Z
0083 FE10     CP   10H
0085 D8       RET  C
0086 FE18     CP   18H
0088 3F       CCF
0089 D8       RET  C
008A 23       INC  HL
008B FE16     CP   16H
008D 3801     JR   C,0090H
008F 23       INC  HL
0090 37       SCF
0091 225D5C   LD   (5C5DH),HL
0094 C9       RET
0095 BF       CP   A
0096 52       LD   D,D
0097 4E       LD   C,(HL)
0098 C4494E   CALL NZ,4E49H
009B 4B       LD   C,E
009C 45       LD   B,L
```

Fig. 2. The first screenfull of data you get, should you type in D126.

```
0096H  52 4E C4 49 4E 4B 45 59
009EH  A4 50 C9 46 CE 50 4F 49
00A6H  4E D4 53 43 52 45 45 4E
00AEH  A4 41 54 54 D2 41 D4 54
00B6H  41 C2 56 41 4C A4 43 4F
00BEH  44 C5 56 41 CC 4C 45 CE
00C6H  53 49 CE 43 4F D3 54 41
00CEH  CE 41 53 CE 41 43 D3 41
00D6H  54 CE 4C CE 45 58 D0 49
00DEH  4E D4 53 51 D2 53 47 CE
00E6H  41 42 D3 50 45 45 CB 49
00EEH  CE 55 53 D2 53 54 52 A4
00F6H  43 48 52 A4 4E 4F D4 42
00FEH  49 CE 4F D2 41 4E C4 3C
0106H  BD 3E BD 3C BE 4C 49 4E
010EH  C5 54 48 45 CE 54 CF 53
0116H  54 45 D0 44 45 46 20 46
011EH  CE 43 41 D4 46 4F 52 4D
0126H  41 D4 4D 4F 56 C5 45 52
012EH  41 53 C5 4F 50 45 4E 20
0136H  A3 43 4C 4F 53 45 20 A3
```

Fig. 3. The first screenfull output to the printer from N150.

```
0096H  RNDINKEY$PIFNPOI
00A6H  NTSCREEN$ATTRATT
00B6H  ABVAL$CODEVALLEN
00C6H  SINCOSTANASNACSA
00D6H  TNLNEXPINTSQRSGN
00E6H  ABSPEEKINUSRSTR$
00F6H  CHR$NOTBINORAND<
0106H  =>=<>LINETHENTOS
0116H  TEPDEF FNCATFORM
0126H  ATMOVEERASEOPEN
0136H  #CLOSE #MERGEVER
0146H  IFYBEEPCIRCLEINK
0156H  PAPERFLASHBRIGHT
0166H  INVERSEOVEROUTLP
0176H  RINTLLISTSTOPREA
0186H  DDATARESTORENEWB
0196H  ORDERCONTINUEDIM
01A6H  REMFORGO TOGO SU
01B6H  BINPUTLOADLISTLE
01C6H  TPAUSENEXTPOKEPR
01D6H  INTPLOTRUNSAVERA
```

Fig. 4. The output from the first page of data from the command, A150.

sidered. If a meaningless address is typed (such as D, DFF, D123456 or D-1) then the command will be ignored.

The disassembler displays the contents of memory one screenfull (21 lines) at a time. Figure 2 shows a disassembly of the first screenfull of the Spectrum ROM. The left-hand column shows the address of the instruction. It is followed on the same line by a hexadecimal representation of the instruction, and then the assembly language text. After 21 lines have been displayed, the prompt 'More? (Enter = No)' will appear. Press any alphabetic or numeric key and the listing will continue on a new screen. Press the Enter key to return to the menu.

After each line is displayed, the program checks to see whether or not a key has been pressed. The Space key pauses the display, which will continue when any alphanumeric key is pressed. The Enter key causes disassembly to cease and the menu is displayed.

Magic numbers?

The third option allows display of the numeric contents of memory. Although the disassembler does this, it only lists between one and four bytes per line (depending upon the instruction). The N command allows eight bytes to be listed on each line of the display. A start address may be specified in Hex or decimal, just as for the D command.

The N command is useful for displaying the contents of tables used by a program or the ROM. Type 'N150' to see the Spectrum reserved-word table. That is where ZX BASIC stores the spellings of words such as PRINT and RETURN. The words are stored in a modified version of ASCII code — the last letter of each word has 128 (80H) added to it, to make it easy for the ROM routine which displays words to find where each one starts and ends.

If you found the numeric representation of the BASIC words rather hard to follow, you can use the command A150 to display the reserved word table in character form. The command uses 7-bit ASCII values, so that letters with 128 added to their code still print out correctly. To avoid changing colours or moving the cursor unexpectedly, the ASCII output routine displays control characters (those with a code less than 32) as full stops.

You can use the Space and Enter keys to control listings

Hex	Z80 Assembler	– after CB	– after ED	Hex	Z80 Assembler	– after CB	– after ED
ØØ	nop	rlc b		4A	ld c,d	bit 1,d	adc hl,bc
Ø1	ld bc,NN	rlc c		4B	ld c,e	bit 1,e	ld bc,(NN)
Ø2	ld (bc),a	rlc d		4C	ld c,h	bit 1,h	
Ø3	inc bc	rlc e		4D	ld c,l	bit 1,l	reti
Ø4	inc b	rlc h		4E	ld c,(hl)	bit 1,(hl)	
Ø5	dec b	rlc l		4F	ld c,a	bit 1,a	ld r,a
Ø6	ld b,N	rlc (hl)		5Ø	ld d,b	bit 2,b	in d,(c)
Ø7	rlca	rlc a		51	ld d,c	bit 2,c	out (c),d
Ø8	ex af,af'	rrc b		52	ld d,d	bit 2,d	sbc hl,de
Ø9	add hl,bc	rrc c		53	ld d,e	bit 2,e	ld (NN),de
ØA	ld a,(bc)	rrc d		54	ld d,h	bit 2,h	
ØB	dec bc	rrc e		55	ld d,l	bit 2,l	
ØC	inc c	rrc h		56	ld d,(hl)	bit 2,(hl)	im 1
ØD	dec c	rrc l		57	ld d,a	bit 2,a	ld a,i
ØE	ld c,N	rrc (hl)		58	ld e,b	bit 3,b	in e,(c)
ØF	rrca	rrc a		59	ld e,c	bit 3,c	out (c),e
1Ø	djnz DIS	rl b		5A	ld e,d	bit 3,d	adc hl,de
11	ld de,NN	rl c		5B	ld e,e	bit 3,e	ld de,(NN)
12	ld (de),a	rl d		5C	ld e,h	bit 3,h	
13	inc de	rl e		5D	ld e,l	bit 3,l	
14	inc d	rl h		5E	ld e,(hl)	bit 3,(hl)	im 2
15	dec d	rl l		5F	ld e,a	bit 3,a	ld a,r
16	ld d,N	rl (hl)		6Ø	ld h,b	bit 4,b	in h,(c)
17	rla	rl a		61	ld h,c	bit 4,c	out (c),h
18	jr DIS	rr b		62	ld h,d	bit 4,d	sbc hl,hl
19	add hl,de	rr c		63	ld h,e	bit 4,e	ld (NN),hl
1A	ld a,(de)	rr d		64	ld h,h	bit 4,h	
1B	dec de	rr e		65	ld h,l	bit 4,l	
1C	inc e	rr h		66	ld h,(hl)	bit 4,(hl)	
1D	dec e	rr l		67	ld h,a	bit 4,a	rrd
1E	ld e,N	rr (hl)		68	ld l,b	bit 5,b	in l,(c)
1F	rra	rr a		69	ld l,c	bit 5,c	out (c),l
2Ø	jr nz,DIS	sla b		6A	ld l,d	bit 5,d	adc hl,hl
21	ld hl,NN	sla c		6B	ld l,e	bit 5,e	ld hl,(NN)
22	ld (NN),hl	sla d		6C	ld l,h	bit 5,h	
23	inc hl	sla e		6D	ld l,l	bit 5,l	
24	inc h	sla h		6E	ld l,(hl)	bit 5,(hl)	
25	dec h	sla l		6F	ld l,a	bit 5,a	rld
26	ld h,N	sla (hl)		7Ø	ld (hl),b	bit 6,b	in f,(c)
27	daa	sla a		71	ld (hl),c	bit 6,c	
28	jr z,DIS	sra b		72	ld (hl),d	bit 6,d	sbc hl,sp
29	add hl,hl	sra c		73	ld (hl),e	bit 6,e	ld (NN),sp
2A	ld hl,(NN)	sra d		74	ld (hl),h	bit 6,h	
2B	dec hl	sra e		75	ld (hl),l	bit 6,l	
2C	inc l	sra h		76	halt	bit 6,(hl)	
2D	dec l	sra l		77	ld (hl),a	bit 6,a	
2E	ld l,N	sra (hl)		78	ld a,b	bit 7,b	in a,(c)
2F	cpl	sra a		79	ld a,c	bit 7,c	out (c),a
3Ø	jr nc,DIS			7A	ld a,d	bit 7,d	adc hl,sp
31	ld sp,NN			7B	ld a,e	bit 7,e	ld sp,(NN)
32	ld (NN),a			7C	ld a,h	bit 7,h	
33	inc sp			7D	ld a,l	bit 7,l	
34	inc (hl)			7E	ld a,(hl)	bit 7,(hl)	
35	dec (hl)			7F	ld a,a	bit 7,a	
36	ld (hl),N			8Ø	add a,b	res Ø,b	
37	scf			81	add a,c	res Ø,c	
38	jr c,DIS	srl b		82	add a,d	res Ø,d	
39	add hl,sp	srl c		83	add a,e	res Ø,e	
3A	ld a,(NN)	srl d		84	add a,h	res Ø,h	
3B	dec sp	srl e		85	add a,l	res Ø,l	
3C	inc a	srl h		86	add a,(hl)	res Ø,(hl)	
3D	dec a	srl l		87	add a,a	res Ø,a	
3E	ld a,N	srl (hl)		88	adc a,b	res 1,b	
3F	ccf	srl a		89	adc a,c	res 1,c	
4Ø	ld b,b	bit Ø,b	in b,(c)	8A	adc a,d	res 1,d	
41	ld b,c	bit Ø,c	out (c),b	8B	adc a,e	res 1,e	
42	ld b,d	bit Ø,d	sbc hl,bc	8C	adc a,h	res 1,h	
43	ld b,e	bit Ø,e	ld (NN),bc	8D	adc a,l	res 1,l	
44	ld b,h	bit Ø,h	neg	8E	adc a,(hl)	res 1,(hl)	
45	ld b,l	bit Ø,l	retn	8F	adc a,a	res 1,a	
46	ld b,(hl)	bit Ø,(hl)	im Ø	9Ø	sub b	res 2,b	
47	ld b,a	bit Ø,a	ld i,a	91	sub c	res 2,c	
48	ld c,b	bit 1,b	in c,(c)	92	sub d	res 2,d	
49	ld c,c	bit 1,c	out (c),c	93	sub e	res 2,e	

Hex	Z80 Assembler	– after CB	– after ED
94	sub h	res 2,h	
95	sub l	res 2,l	
96	sub (hl)	res 2,(hl)	
97	sub a	res 2,a	
98	sbc a,b	res 3,b	
99	sbc a,c	res 3,c	
9A	sbc a,d	res 3,d	
9B	sbc a,e	res 3,e	
9C	sbc a,h	res 3,h	
9D	sbc a,l	res 3,l	
9E	sbc a,(hl)	res 3,(hl)	
9F	sbc a,a	res 3,a	
AØ	and b	res 4,b	ldi
A1	and c	res 4,c	cpi
A2	and d	res 4,d	ini
A3	and e	res 4,e	outi
A4	and h	res 4,h	
A5	and l	res 4,l	
A6	and (hl)	res 4,(hl)	
A7	and a	res 4,a	
A8	xor b	res 5,b	ldd
A9	xor c	res 5,c	cpd
AA	xor d	res 5,d	ind
AB	xor e	res 5,e	outd
AC	xor h	res 5,h	
AD	xor l	res 5,l	
AE	xor (hl)	res 5,(hl)	
AF	xor a	res 5,a	
B0	or b	res 6,b	ldir
B1	or c	res 6,c	cpir
B2	or d	res 6,d	inir
B3	or e	res 6,e	otir
B4	or h	res 6,h	
B5	or l	res 6,l	
B6	or (hl)	res 6,(hl)	
B7	or a	res 6,a	
B8	cp b	res 7,b	lddr
B9	cp c	res 7,c	cpdr
BA	cp d	res 7,d	indr
BB	cp e	res 7,e	otdr
BC	cp h	res 7,h	
BD	cp l	res 7,l	
BE	cp (hl)	res 7,(hl)	
BF	cp a	res 7,a	
CØ	ret nz	set Ø,b	
C1	pop bc	set Ø,c	
C2	jp nz,NN	set Ø,d	
C3	jp NN	set Ø,e	
C4	call nz,NN	set Ø,h	
C5	push bc	set Ø,l	
C6	add a,N	set Ø,(hl)	
C7	rst Ø	set Ø,a	
C8	ret z	set 1,b	
C9	ret	set 1,c	
CA	jp z,NN	set 1,d	
CB		set 1,e	
CC	call z,NN	set 1,h	
CD	call NN	set 1,l	
CE	adc a,N	set 1,(hl)	
CF	rst 8	set 1,a	

Hex	Z80 Assembler	– after CB	– after ED
DØ	ret nc	set 2,b	
D1	pop de	set 2,c	
D2	jp nc,NN	set 2,d	
D3	out (N),a	set 2,e	
D4	call nc,NN	set 2,h	
D5	push de	set 2,l	
D6	sub N	set 2,(hl)	
D7	rst 16	set 2,a	
D8	ret c	set 3,b	
D9	exx	set 3,c	
DA	jp c,NN	set 3,d	
DB	in a,(N)	set 3,e	
DC	call c,NN	set 3,h	
DD	prefixes instructions using ix	set 3,l	
DE	sbc a,N	set 3,(hl)	
DF	rst 24	set 3,a	
EØ	ret po	set 4,b	
E1	pop hl	set 4,c	
E2	jp po,NN	set 4,d	
E3	ex (sp),hl	set 4,e	
E4	call po,NN	set 4,h	
E5	push hl	set 4,l	
E6	and N	set 4,(hl)	
E7	rst 32	set 4,a	
E8	ret pe	set 5,b	
E9	jp (hl)	set 5,c	
EA	jp pe,NN	set 5,d	
EB	ex de,hl	set 5,e	
EC	call pe,NN	set 5,h	
ED		set 5,l	
EE	xor N	set 5,(hl)	
EF	rst 40	set 5,a	
FØ	ret p	set 6,b	
F1	pop af	set 6,c	
F2	jp p,NN	set 6,d	
F3	di	set 6,e	
F4	call p,NN	set 6,h	
F5	push af	set 6,l	
F6	or N	set 6,(hl)	
F7	rst 48	set 6,a	
F8	ret m	set 7,b	
F9	ld sp,hl	set 7,c	
FA	jp m,NN	set 7,d	
FB	ei	set 7,e	
FC	call m,NN	set 7,h	
FD	prefixes instructions using iy	set 7,l	
FE	cp N	set 7,(hl)	
FF	rst 56	set 7,a	

Fig. 5. The complete Spectrum Hex codes with their corresponding assembly language mnemonics. As certain Z80 instructions are compounds starting with CBh or EDh, the two right-hand columns give these. These tables have been reprinted from Appendix A of the Sinclair Spectrum manual.

output by commands N and A, just as you would for a disassembly. Every 21 lines the 'More? (Enter = No)' message will appear before a new screen is started.

The final two commands don't output anything themselves, but they do change the output which the others generate. When you first RUN Spectramon, the message 'P Printer option (Now ON)' appears. Type the command 'P' followed by Enter and the message will become 'P Printer option (Now ON)'. If you then display memory contents (using A, N or D) the information will be sent to the printer as well as the television. Once you've finished printing, press Enter to stop the display and then use the command P to switch the printer option off again.

Notice that the printer routine does not output any lines until an entire screen-full has been generated. In fact, it deliberately avoids using the LPRINT statement to send each line to the printer. Instead it uses COPY, the ZX BASIC command which sends all of the text on the screen to the printer. That's because it is almost twice as fast to build up a full screenfull of data and then print it using COPY than it is to use LPRINT for each line as it is generated.

The printer can't stop and start very quickly and consequently the LPRINT statement is much slower than COPY — the printer must rev up and slow down 21 times (once for each line) instead of just once. In fact, the printer always outputs the last line of a group at half speed, to make sure that everything falls in the correct place when it stops. As far as it is concerned each LPRINT is the last line of a group (when there's less than 33 characters being printed).

Base choice

The final option allows the user to select the base in which numbers are output by the program. Sometimes it is useful to have numbers printed in decimal (for example, when refering to addresses mentioned in the Spectrum manual) and sometimes hexadecimal is more convenient (when displaying address tables or working out jump offsets). Type the command 'B' to change the output base. When you first run Spectramon it will be Hex (hence the display 'B Base selection (Now = HEX)') but you can switch it to decimal with the B command. If you wish to re-select Hex output later you can 'toggle' back by typing 'B' again.

If an unknown command is entered, Spectramon will ignore it. If it is called upon to show the contents of non-existent memory (past address 65535) it will display the message 'End of Memory'. If the end of memory is encountered while the program is half-way through processing a line of numbers or ASCII characters, it will fill the rest of the line with zeros or spaces.

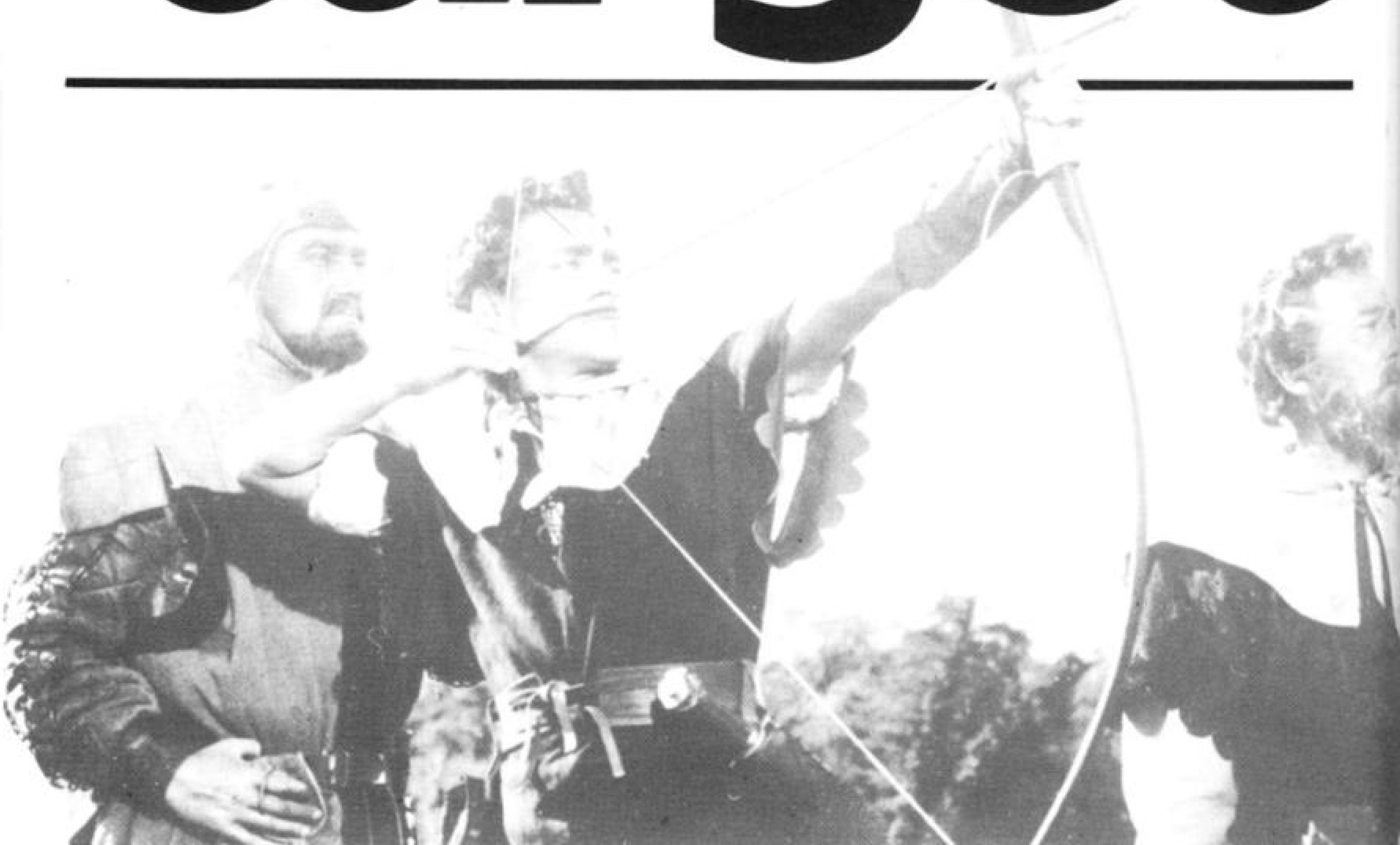
If you have to stop the monitor for any reason by typing Break (perhaps because your desk has melted from under the computer or the ZX printer is strangling itself) you can re-start Spectramon by entering GO TO 200 after the panic is over. So long as you've not typed LOAD, CLEAR or NEW in the meantime, the menu will appear immediately (without the 15 second wait for table set-up) and the current base (Hex or decimal) will be preserved.

The next byte . . .

The second part of this article, complete with program listing for Spectramon, will be published in the June/July issue of *ZX Computing*. In the meantime, if you can't wait to try out Spectramon for yourself, a tape of the program is now available from ASP Software priced at £5.99. For more details, check out the advertisement elsewhere in this issue.

On target

Fifteen year old Timothy Parnell of Ipswich has contributed two great programs for the unexpanded ZX81.



Target

When RUN, this program displays a target and a randomly placed star near the centre of the screen. You must then, using the 'N' key to move left and the 'M' key to move right, position the target so that the star is in the middle of it. Pressing the 'X' key will then fire at the star.

Confirmation of a hit on the star is given by the star turning to inverse video. The program ends if you fail to hit a star.

You set the difficulty of the game yourself at the beginning of the game; if you input a value below 15, the game is very hard indeed! The difficulty is calculated in the FOR...TO loop in line 50.

Missile launcher

In this program, you control a ground-based missile launcher with which you can fire missiles at oncoming alien attackers.

You can move your missile launcher using the 'N' key to go right and the 'M' key to go left. The 'Z' key is used to launch the missile. You can cheat by holding the 'Z' key down all the time as you move, but this will show up at the end of the game when the number of shots you took is displayed.

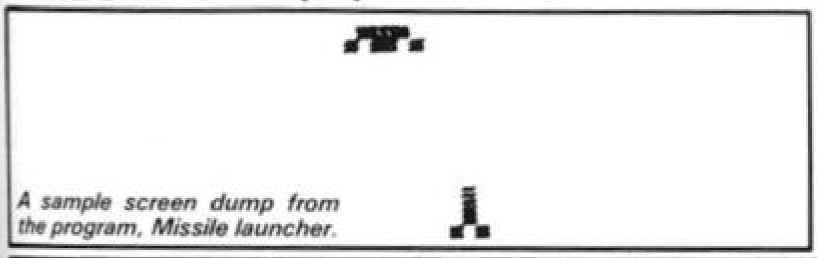
The game can be altered so that the missile rises at a faster rate. This is done by changing line 150 to read:

```
150 IF B<=19 THEN LET
      B=B-2
```

If you make this change, you should also alter line 70 to read:

```
70  IF B<=0 THEN LET
      B=20
```

```
  5 LET S=0
 10 LET X=15
 20 LET Z=0
 30 LET Y=0
 40 LET B=20
 50 PRINT AT B,X;"█"
 60 PRINT AT B+1,X;"▗▚ "
 70 IF B=0 THEN LET B=20
 80 PRINT AT Y,Z-1;"▗██▖"
 90 LET Z=Z+1
100 IF Z=31 THEN LET Y=Y+5
110 IF Z=31 THEN LET Z=0
120 IF INKEY$="N" THEN LET X=X-
1
130 IF INKEY$="M" THEN LET X=X+
1
140 IF INKEY$="Z" THEN LET B=19
145 IF INKEY$="Z" THEN LET S=S+
1
150 IF B<=19 THEN LET B=B-1
160 IF Y=20 AND Z=X THEN GOTO 2
90
170 IF X=Z AND B+1=Y THEN GOTO
300
180 CLS
190 GOTO 50
290 PRINT AT 10,6;"ALIENS HAVE
LANDED"
298 STOP
300 PRINT AT 10,0;"  YOU HIT TH
E ALIEN IN ";S;" SHOTS"
```


A sample screen dump from the program, Missile launcher.

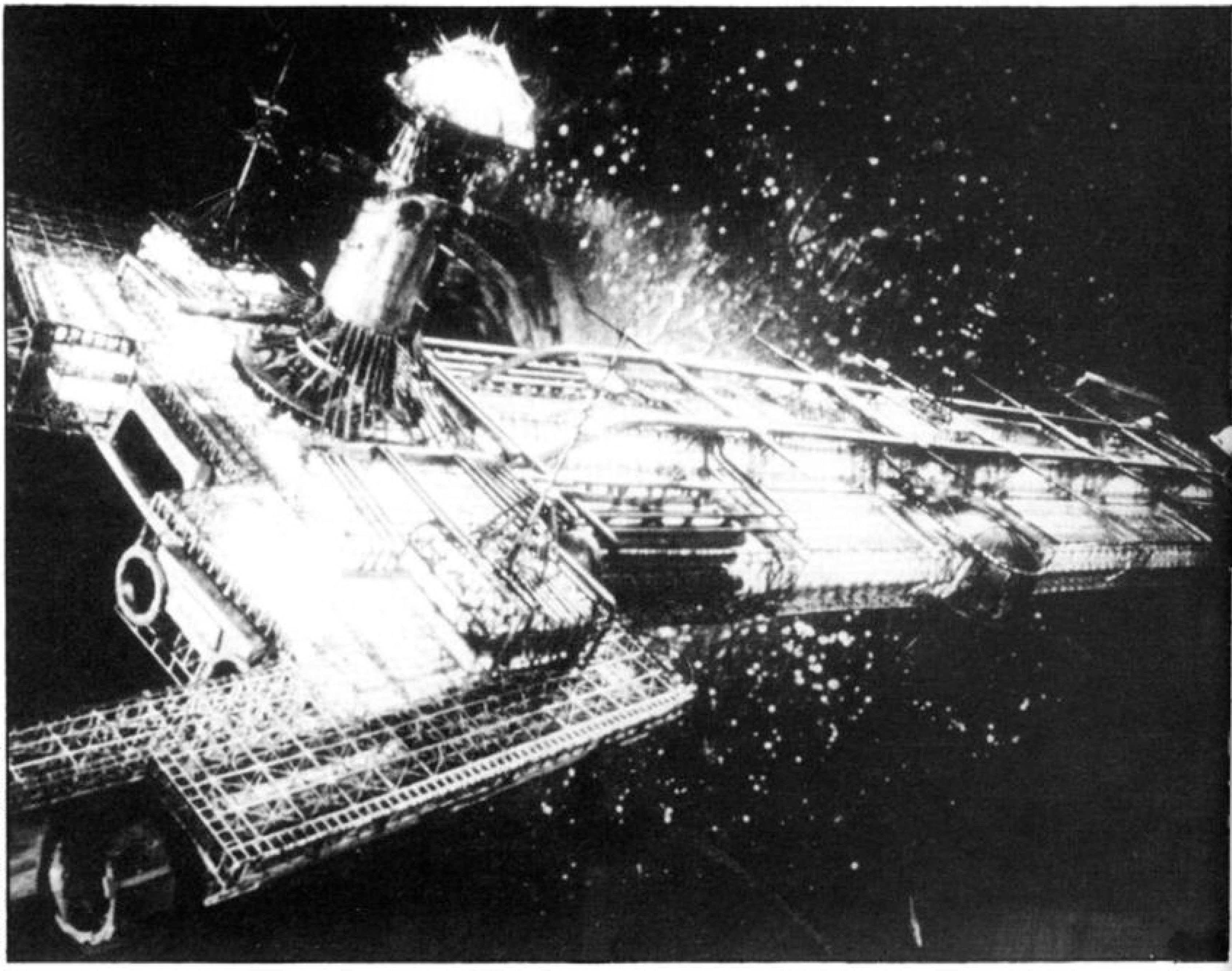
```
  5 PRINT "INPUT DIFFICULTY"
  6 INPUT D
  7 CLS
 10 LET S=0
 20 LET X=10
 30 LET Y=10
 40 LET V=INT (RND*28)
 50 FOR T=1 TO D
 60 PRINT AT X,Y;" I ";AT X+4,Y
;" I ";AT X+2,Y+2;" - ";AT X+2,Y
-2;" - "
100 LET Y=Y+(INKEY$="M")-(INKEY
$="N")
120 IF INKEY$="X" AND Y+2=V+1 T
HEN GOTO 160
130 PRINT AT 12,V;"*"
140 NEXT T
150 PRINT AT 0,10;"YOU HIT ";S
155 STOP
160 PRINT AT 12,V;"▦"
170 LET S=S+1
180 PAUSE 50
185 CLS
190 GOTO 20
```



A sample screen dump from the program, Target.

Asteroids ahead

Steer your spacecraft clear of the asteriods in this exciting game from Mr Bish of Exeter.



There you are, a lonely spaceship floating through space, when suddenly your peace is shattered by a swarm of asteroids bearing down on you at a great rate of knots. You can manoeuver your craft left using the '5' key or right with the '8' key. You also possess an energy field which you can use to deflect asteroids you cannot avoid, but beware of running out of energy — the energy field has only a limited strength and a short range.

User defined graphics have been used in this program for the asteroids, the energy screen, the spacecraft and the explosions. They are set during the initial display, thus not causing an embarrassing pause during the game.

Logic lines have been used within the program. The most well-known example of these are present in line 50, but you may like to study the less popular conditional GOTO used in line 405. Also, the use of ATTR to detect the presence of a white asteroid in the path of the yellow spacecraft should be noted; SCREEN $ (x,y) would not work with user defined graphics.

Line 460, which goes to itself, is used to prevent a STOP message from spoiling the appearance of the screen. Press the Break key to stop the vicious circle.

It should also be noted that the capital letters within quotes in lines 62, 100 and 400 are user defined graphics and as such should be entered in Graphics mode.

The program is also equipped with a routine to give your score and the best score achieved, and there is also a best-ever score with the initials of the player who managed to build up that score. To operate the best-ever score option, enter:

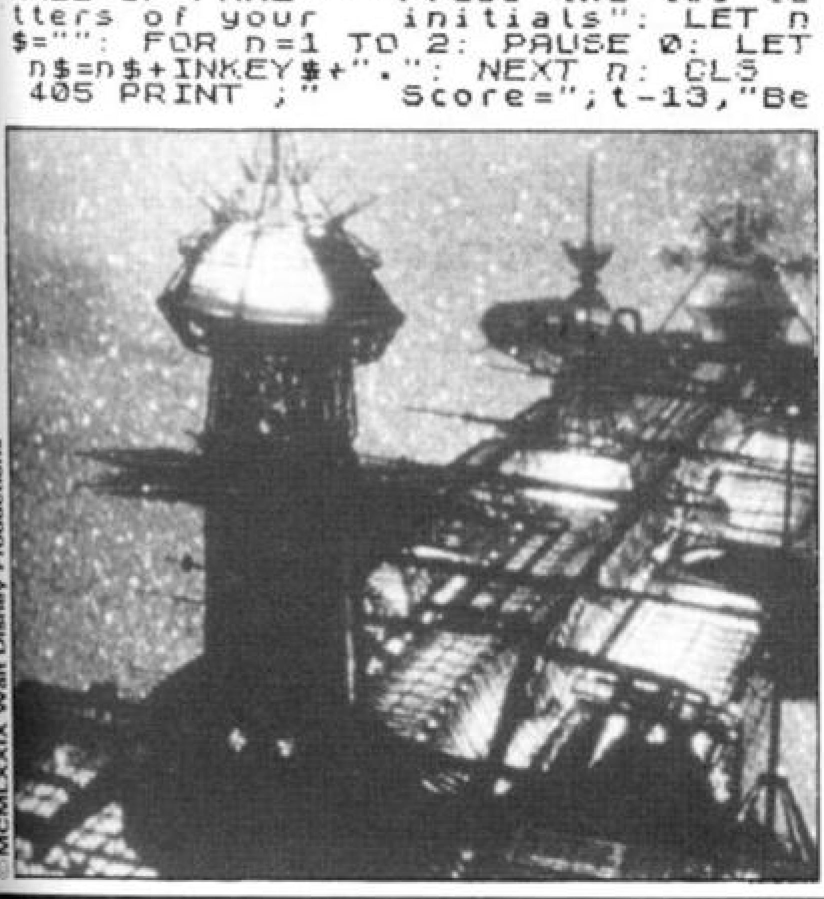
LET e = 0

as a command, and then SAVE using:

GOTO 430

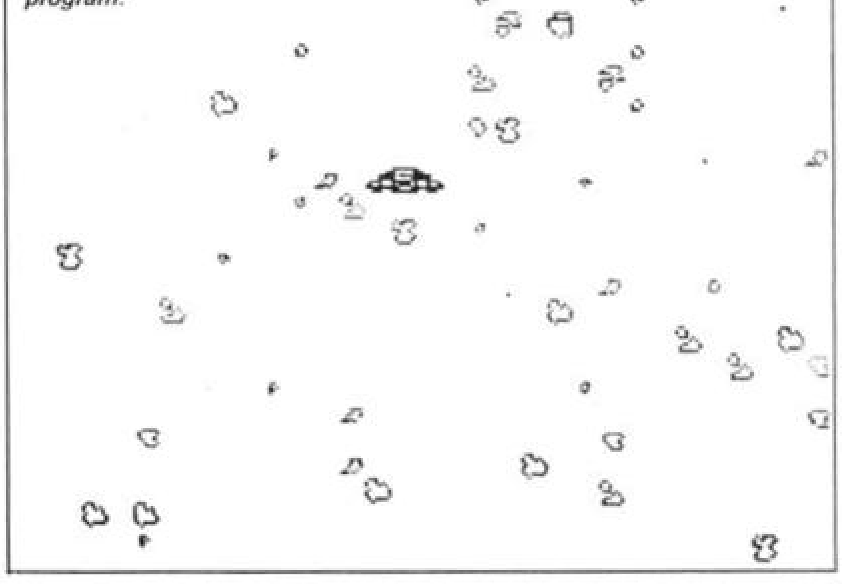
The program, when LOADed, will GOTO line 1 and execute itself, complete with variables.

```
   1 BORDER 1: PAPER 1: CLS : IN
K 7: PRINT AT 0,8; FLASH 1;"ASTE
ROIDS AHEAD!": PAUSE 100: PRINT 
FLASH 0;''" Steer your spacecraf
t through   the swarm of asteroi
ds"''"Press 5 for Left or 8 for 
Right."''"Press 0 to activate yo
ur craft'sEnergy Screen to destr
oy          asteroids you cannot a
void"''"But BEWARE - the Screen 
has onlya short range and you ha
ve only 5 energy units left"''"
Your craft will disintegrate
after 5 hits (wings=1,body=2)"''
"   HOW LONG CAN YOU SURVIVE?":
GO SUB 9000: PRINT '"          Pre
ss 8 to start": PAUSE 0: LET b=0
  10 INK 0: CLS : LET t=0: LET p
=5: LET l=15: LET l1=l: LET f=6
  50 POKE 23692,255: LET l=l+(IN
KEY$="8" AND l<29)-(INKEY$="5" A
ND l>0) : IF INKEY$="0" THEN LET
 f=f-1: IF f>0 THEN PRINT AT 8,l;
 INK 6;"PQR": GO TO 64
  62 IF INKEY$="0" THEN LET f=f-
1: IF f>0 THEN PRINT AT 8,l; INK
 6;"PQR"
  64 IF ATTR (8,l+2)=15 OR ATTR 
(8,l)=15 THEN LET p=p-1
  66 IF ATTR (8,l+1)=15 THEN LET
 p=p-2
  67 IF p<1 THEN GO TO 400
 100 PRINT AT 7,l1;"   ";AT 21,3
1;"": PRINT : PRINT AT 7,l; INK
6;"S"; INVERSE 1;p; INVERSE 0;"T
": LET t=t+1: LET l1=l: PRINT AT
 21,RND*31; INK 7;CHR$ (RND*11+1
44);AT 21,RND*31;CHR$ (RND*11+14
4): GO TO 50
 400 FOR n=1 TO 3: PRINT AT 6,l1
;"   ";AT 7,l1; INK 2;" M ";AT 8
,l1;"   ": PAUSE 2: PRINT AT 6,l
1; INK 6;"OQU";AT 7,l1;"N N";AT
8,l1;"PQR": PAUSE 2: NEXT n: FOR
 n=6 TO 8: PRINT AT n,l1;"     ":
 NEXT n
 402 CLS : IF b<t-13 THEN LET b=
t-13
 403 INK 7: IF e<b THEN LET e=b:
 PRINT AT 6,0;"You have beaten t
he best ever   score. Enter the
HALL OF FAME"''"Press the two le
tters of your    initials": LET n
$="": FOR n=1 TO 2: PAUSE 0: LET
 n$=n$+INKEY$+".": NEXT n: CLS
 405 PRINT ;"     Score=";t-13,"Be
st Score=";b''"   Best ever Scor
e=";: PRINT FLASH 1;e;" by ";n$'
'': FOR n=1 TO 150: NEXT n: PRIN
T FLASH 0;"   Press p to play ag
ain"''''             s to save''''
          f to finish": PAUSE 0: GO
TO (5 AND INKEY$="p")+(430 AND I
NKEY$="s")+(450 AND INKEY$="f")
 430 SAVE "asteroids" LINE 1
 450 PRINT ''''"   Thank you for 
playing.  'Bye"
 460 GO TO 460
9020 RESTORE 9070: FOR m=1 TO 21
9030 READ p$
9040 FOR n=0 TO 7
9050 READ a: POKE USR p$+n,a
9060 NEXT n: NEXT m: RETURN
9065 BORDER 1: PAPER 1: CLS : IN
K 7: GO TO 2
9070 DATA "a",62,33,255,129,129,
65,37,26
9080 DATA "b",112,148,136,65,123
,129,94,32
9090 DATA "c",0,0,24,36,36,56,0,
0
9100 DATA "d",0,0,48,40,48,32,0,
0
9110 DATA "e",0,24,40,40,16,0,0,
0
9120 DATA "f",112,136,136,68,40,
48,0,0
9130 DATA "g",0,0,0,56,44,16,0,0
9140 DATA "h",0,0,30,18,34,84,23
2,0
9150 DATA "i",94,177,130,228,34,
65,66,60
9160 DATA "j",0,62,65,66,34,17,1
4,0
9170 DATA "k",96,144,144,116,10,
49,65,126
9180 DATA "l",62,65,242,9,247,13
6,144,36
9190 DATA "m",145,82,16,7,244,8,
74,137
9200 DATA "n",100,24,198,0,222,0
,24,102
9210 DATA "o",0,4,34,18,1,68,50,
9
9220 DATA "p",9,50,68,1,18,34,4,
0
9230 DATA "q",0,8,170,42,73,65,1
37,137
9240 DATA "r",144,76,34,128,72,6
8,32,0
9250 DATA "s",0,3,15,15,120,200,
255,56
9260 DATA "t",0,192,240,240,30,1
9,255,28
9270 DATA "u",0,32,68,72,128,36,
76,144
```



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An example of the graphics from the program.



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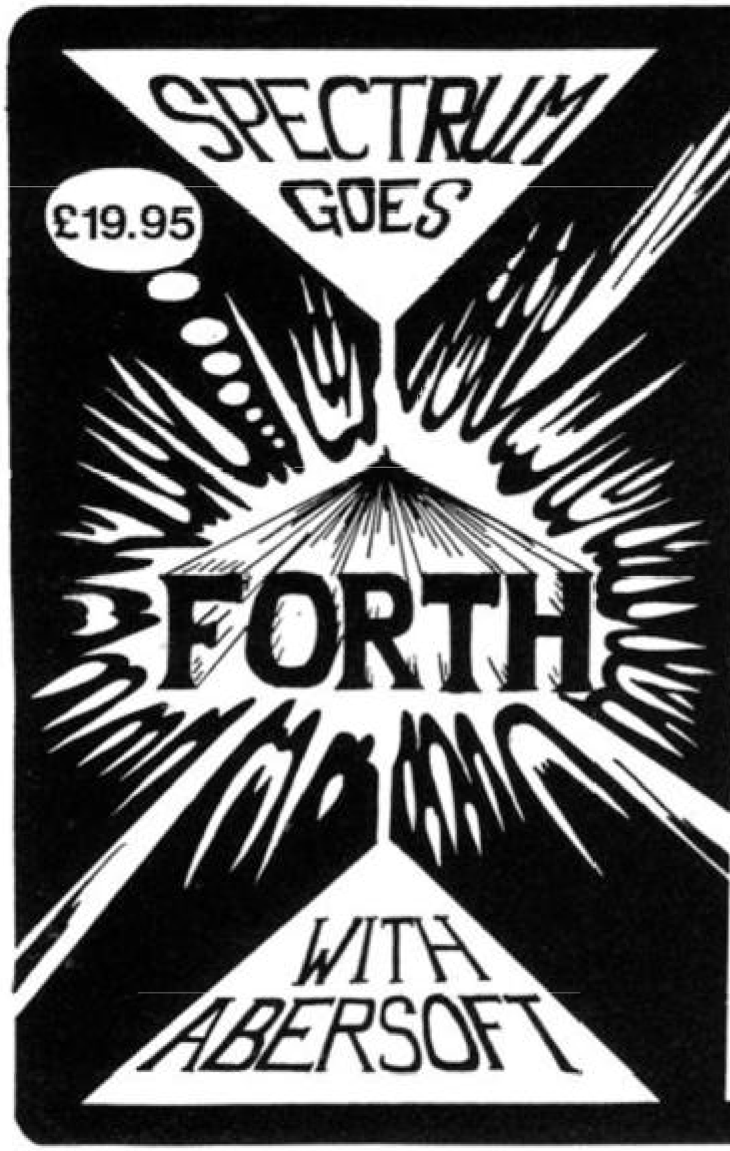
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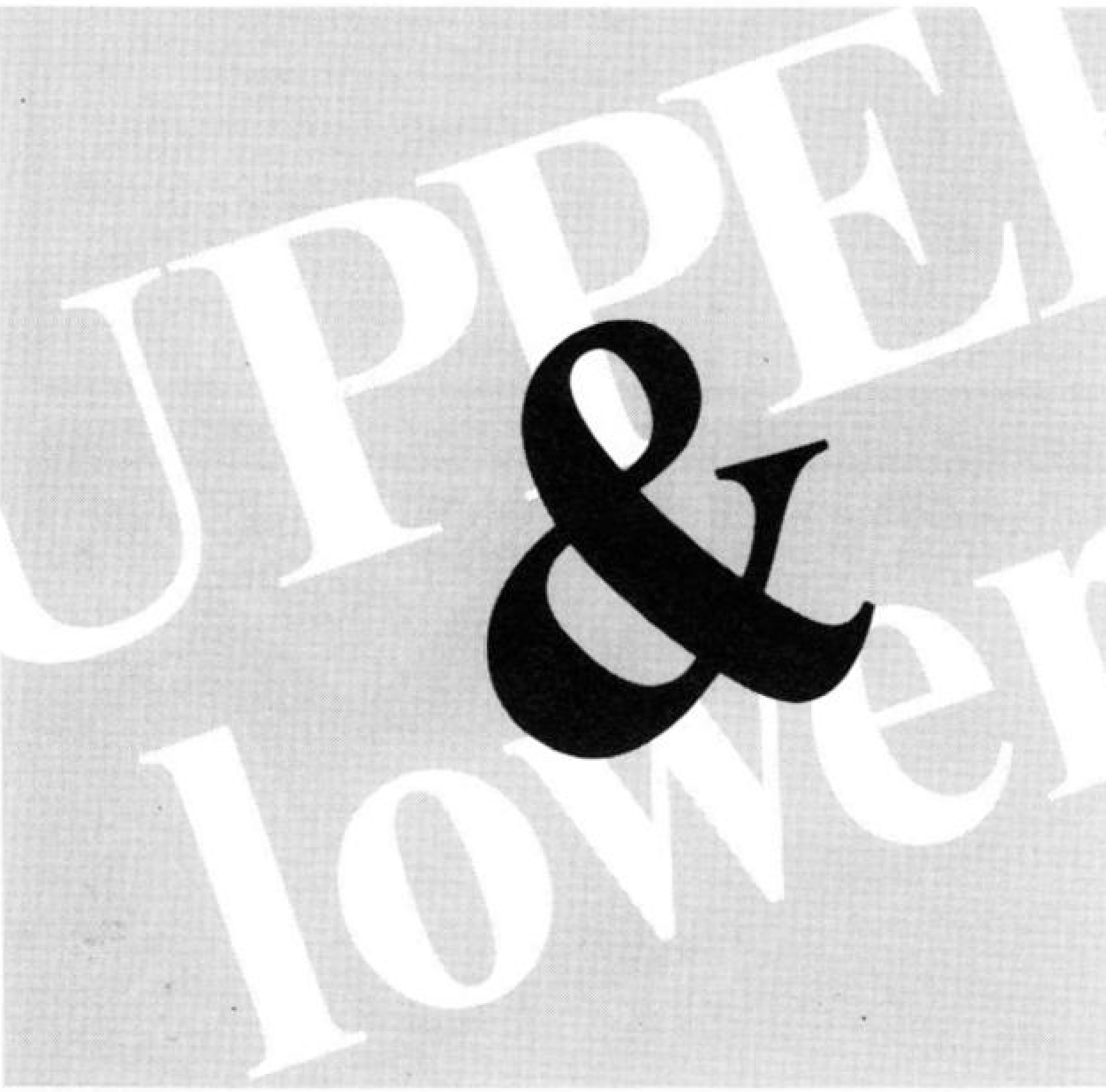
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User character set

Print upper and lower case characters with your ZX81 with this clever program written by David Mold of Cheshunt.



Similar in nature to the user definable graphics program by Chris Callender which appeared in the August/September issue of ZX Computing, this program is rather more flexible in that it will store a character set of up to 99 characters and enable them to be LPRINTed simply by entering a string (X$).

Once you have entered the program, you will be greeted with the prompt:

NOW ENTER THE CODES FOR THE SPECTRUM CHARACTER SET

Simply type in the codes given for the lower case characters (like on the Spectrum), and these will be placed in the array, U.

You will now be given the prompt:

ENTER TEXT TO BE LPRINTED USING NEW CHARACTER SET

At this stage, you simply enter what you would like to be printed in upper and lower case.

Any letters you enter as normal video will be printed in lower case. Any letters entered as inverse video will be printed as upper case. Numbers entered as inverse video will actually be printed as normal video numbers, whereas if any numbers are entered as normal video, they will be printed as the extra characters which have been defined for them.

Extra,extra

If you have entered your own characters, having answered 'Y' to the prompt:

DO YOU WANT TO ENTER YOUR OWN USER-DEFINED CHARACTERS? (Y OR N)

then they can be obtained by typing in the graphics corresponding to the Sinclair codes 1 to 10 (for details check out Appendix A of the Sinclair ZX81 manual). For example, CHR$ 1 corresponds to the first user-definable graphic.

Character definition should only be attempted if you understand the way that a character is made up from binary numbers (eight for each character). These numbers must then be translated into decimal to be typed into the program. The extra graphics characters, along with the number that has to be entered to produce them is shown in Fig. 1.

Line by line

Before typing in or re-LOADing this program from tape, it is important that you enter the following two lines (each followed by Newline) as direct commands:

```
POKE 16389,124
NEW
```

in order to reserve space above RAMtop for the LPRINT routine which is copied out from the ROM in lines 10 to 50.

Here follows a brief breakdown of the structure of the program.

Lines 100 to 170 copy from the ROM into the array S, all the codes for Sinclair's characters, from '0' to 'Z' (normal video).
Lines 200 to 270 copy from the ROM into the array U, all the extra Sinclair symbols, such as '*', ';', etc. These will then be obtainable directly when the program is in use.
Lines 300 to 370 allow the user to enter the codes for the lower case characters into the array U. (These codes are shown in Fig. 1). Every other line of this printout has the codes to be entered, separated by '/' to represent Newline, and above each set of codes is the number that should appear at the top of the screen

when these codes are to be entered (and represent the codes' positions in the array U). Lines 400 to 480 allow you to define your own graphics characters, and enter them in decimal form.

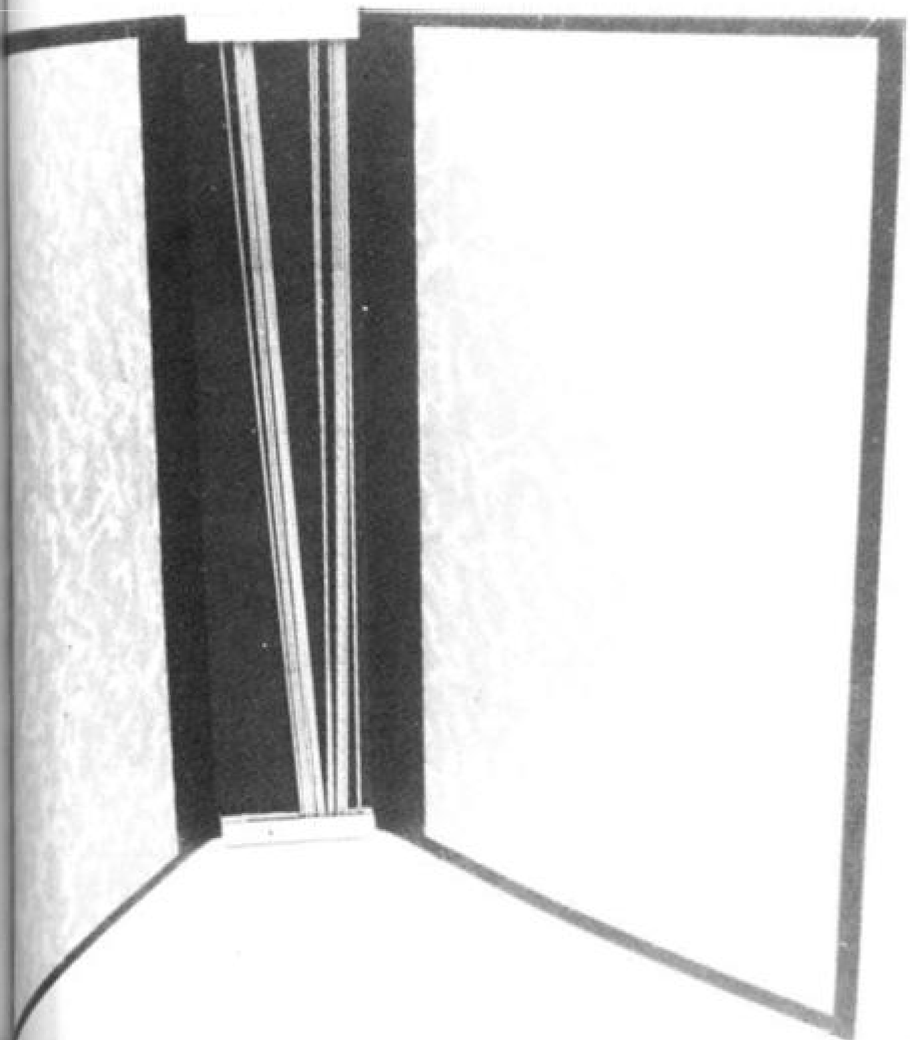
Lines 500 to 700 allow you to enter whatever you wish to be printed using the new character set, and then looks up the codes for these characters in the appropriate arrays, mapping them into the array A, for LPRINTing using the subroutine from Sinclair's printer manual (lines 9990 to 9999). When all the arrays have been entered, lines 100 to 500 can be deleted. Line 1 should then be changed to read 1 SAVE "Characters". Connect up your cassette, start it recording, then enter GOTO 1 as a direct command. *Do not use RUN* or the arrays will be wiped. Make sure that all DIM statements have been erased. The program, when LOADed, will begin straight away, which avoids the danger of the user typing RUN instead of GOTO to begin.

```
28
255/0/0/0/0/0/0/0/
29
0/16/16/16/16/0/16/0/
30
60/66/153/165/165/153/64/63/
31
0/36/126/36/36/126/36/0/
32
16/56/88/146/16/16/16/16/
33
0/98/100/8/16/38/70/0/
34
0/48/72/50/76/72/54/0/
35
0/8/8/16/0/0/0/0/
36
0/126/36/36/36/36/36/0/
37
60/66/153/161/161/153/66/60/
38
0/0/60/2/62/66/62/0/
39
0/64/64/124/66/66/124/0/
40
0/0/60/64/64/64/60/0/
41
0/2/2/62/66/66/62/0/
42
0/0/60/66/124/64/62/0/
43
0/12/16/56/16/16/16/0/
44
0/0/60/66/66/62/2/60/
45
0/64/64/120/68/68/68/0/
46
0/16/0/48/16/16/56/0/
47
0/4/0/12/4/4/68/56/
48
0/32/40/48/48/40/36/0/
49
0/32/32/32/32/32/24/0/
50
0/0/104/84/84/84/84/0/
51
0/0/120/68/68/68/68/0/
52
0/0/56/68/68/68/56/0/
53
0/0/120/68/68/120/64/64/
54
0/0/60/68/68/60/4/4/
55
0/0/28/32/32/32/32/0/
56
0/0/60/64/56/4/120/0/
57
0/32/112/32/32/32/24/0/
58
0/0/68/68/68/68/56/0/
59
0/0/68/68/40/40/16/0/
60
0/0/84/84/84/84/40/0/61
0/0/68/40/16/40/68/0/62
0/0/68/68/68/60/4/60/63
0/0/124/8/16/32/124/0/
```

Fig. 1. The codes for the lower case characters — to be entered into the array, U.

```
   1 SAVE "CHARACTERS"
   5 FAST
  10 FOR I=0 TO 112
  20 POKE 31744+I,PEEK (2161+I)
  30 NEXT I
  40 POKE 31800,63
  50 POKE 31857,201
 100 DIM S(36,8)
 110 LET X=7903
 120 FOR N=1 TO 36
 130 FOR P=1 TO 8
 140 LET S(N,P)=PEEK (X+P)
 150 NEXT P
 160 LET X=X+8
 170 NEXT N
 200 DIM U(63,8)
 205 LET X=7767
 210 FOR N=11 TO 27
 220 FOR P=1 TO 8
 230 LET U(N,P)=PEEK (X+P)
 240 NEXT P
 250 LET X=X+8
 260 NEXT N
 270 GOTO 500
 300 PRINT AT 0,0;">NOW ENTER TH
E CODES FOR THE     SPECTRUM CHAR
ACTER SET"
 310 FOR N=28 TO 63
 320 PRINT AT 3,0;N
 330 FOR P=1 TO 8
 340 PRINT AT 4,0;P
 350 INPUT U(N,P)
 360 NEXT P
 370 NEXT N
 400 CLS
 410 PRINT ">DO YOU WANT TO ENTE
R YOUR OWN  USER-DEFINED CHARACT
ER? (Y OR N)"
 420 INPUT A$
 425 IF A$="N" THEN GOTO 500
 430 FOR N=1 TO 10
 440 PRINT AT 3,0;N
 450 FOR P=1 TO 8
 460 PRINT AT 4,0;P
 465 INPUT U(N,P)
 470 NEXT P
 480 NEXT N
 500 CLS
 505 SLOW
 510 PRINT "ENTER TEXT TO BE LPR
INTED USING NEW CHARACTER SET:"
 520 INPUT X$
 522 FAST
 525 DIM A(32,8)
 530 FOR X=1 TO LEN X$
 540 IF X$(X)=" " THEN GOTO 700
 550 IF CODE X$(X)>127 THEN GOTO
 600
 560 FOR Y=1 TO 8
 570 LET A(X,Y)=U(CODE X$(X),Y)
 580 NEXT Y
 590 GOTO 700
 600 FOR Y=1 TO 8
 610 LET A(X,Y)=S(CODE X$(X)-155,
Y)
 620 NEXT Y
 700 NEXT X
9990 FOR J=1 TO 32
9991 FOR K=1 TO 8
9992 POKE 32255+K+8*(J-1),A(J,K)
9993 NEXT K
9994 NEXT J
9995 FOR H=0 TO 31
9996 POKE 16444+H,H
9997 NEXT H
9998 LET HPRINT=USR 31744
9999 GOTO 500
```

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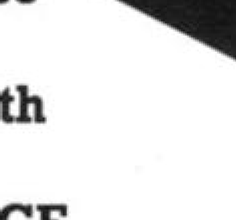


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ZX-CESIL 2 — part one

John Miller has taken a quick break from his A-levels to prepare us a splendid implementation of the educational computer language for your ZX Spectrum.



Those people studying for 'O' level or 'CSE' Computer Studies at school, more than likely have to learn the language CESIL (Computer Education in Schools Interactive Language) which supports 14 program statements as standard and a handful of commands. The language I chose to implement CESIL in was ZX Spectrum BASIC — with 48K RAM. (The use of a ZX Printer is optional.)

Type in the program (*carefully!*) and then enter the command:

RUN 1

Two pages of introduction will be displayed, then you will see the prompt:

Which mode (1 or 2)?

In reply, enter 1 or 2.

Mode 1 means output to screen only and mode 2 means output to both screen and printer. The Spectrum's screen BORDER state depends upon the current mode:

Green for Mode 1
Yellow for Mode 2

When the message 'C?' is output, you are required to enter a CESIL command:

COMMAND	NOTES
beg	Execute the CESIL program.
cha	Change a CESIL line.
del	Delete a CESIL line.
lis	List the CESIL program.
new	Re-initiate program — same as stopping the program and entering RUN 1.
ter	Stop the interpreter — terminate.
*	Start CESIL entry.

When using 'cha' or 'del', the first parameter is the line to be edited (del followed by Enter followed by 5 followed by Enter, will delete the fifth line).

When '?' is output, you are required to enter a CESIL line. Labelled lines are l1 to l99 and store locations are designated a1 to a99 (positive constants do not require '+'). Please note that 'l' means 'label'.

Types of argument

a — The argument required is:
(i) Space, any whole number between − 32768 and + 32768.
or (ii) Space, a ; any integer between 1 and 99.
eg (i) loa − 2
(ii) add a5

b — The argument required is: Space, 'l' , any integer 1 to 99.
eg jiz l10

c — The argument required is: Space, quote, any alphanumeric text of length 1 to 22, close quote.
eg pri ''Hello there!''

INSTRUCTION	PURPOSE	ARGUMENT TYPE
add	Addition	a
div	Division	a
hal	Halt execution	n
in	Input from data	n
jin	Jump if negative	b
jiz	Jump if zero	b
jum	Jump	b
kin	Input from keyboard	n
lin	Start new line	n
loa	Load a number	a
mul	Multiplication	a
out	Output	n
pri	Print	c
sto	Store	d
sub	Subtraction	a
;	Comments	e

d – The argument required is: Space, a, any number 1 to 99 (integer).
eg sto a86

e – The argument required is: Any alpha numeric text of length 1 to 23.
eg ; This is a comment

n – No argument required.

All instructions are standard, except 'kin', which is the same as BASIC's INPUT number. The instruction 'in' is the same as BASIC's READ. All arithmetic is calculated solely using the accumulator.

In order to exit from CESIL 2 entry, enter:

%

As a line, you will then be asked to enter the data string in the form:

n1, n2, n3, . . . nx, *
n1 = item 1
n2 = item 2 . . .
nx = last item
eg. 1, 2, 3, 5, 7, 9, *
(Note the comma before the *)

For no data, just enter an asterisk. (Also, only the first 20 items will be accepted.)

To change the data for another RUN of the same program:

PROMPT	ENTER
C?	*
?	%
Data?	data string

Also, if after entering and executing a CESIL program, entry mode is again initiated and the lines will be added to the end of the previous lines. The number of program lines available is 100 (that's my limit — not the Spectrum's).

To change the maximum number of lines, make the following changes to the BASIC program ($\bar{x}$ = the number instead of 100 — maximum value = 255).

```
20 . . . : DIM p$ (x̄,25):
. . .
1380 FOR x = 1 TO x̄
2030 FOR z = VAL i$ +
     1 TO x̄
3710 If last ln<(x̄ + 1)
     THEN GO TO
     3750
4180 FOR c = 1 TO x̄
```

During CESIL2 execution or CESIL2 listing (lis), command mode may be achieved by pressing the space key — as long as it is unshifted!

Labelled lines

(i) Labels — l1 to l9
The format is l, n, Space, Space, instruction + argument.
eg l1 lin

Also, arguments should be preceded by a single space, in turn preceded by the instruction.

To SAVE the ZX-CESIL 2 program, type in the following:

SAVE "cesil" LINE 4450

The program, with all variables, uses approximately 18K. With the screen, printer buffer, etc, this expands to 25.9K

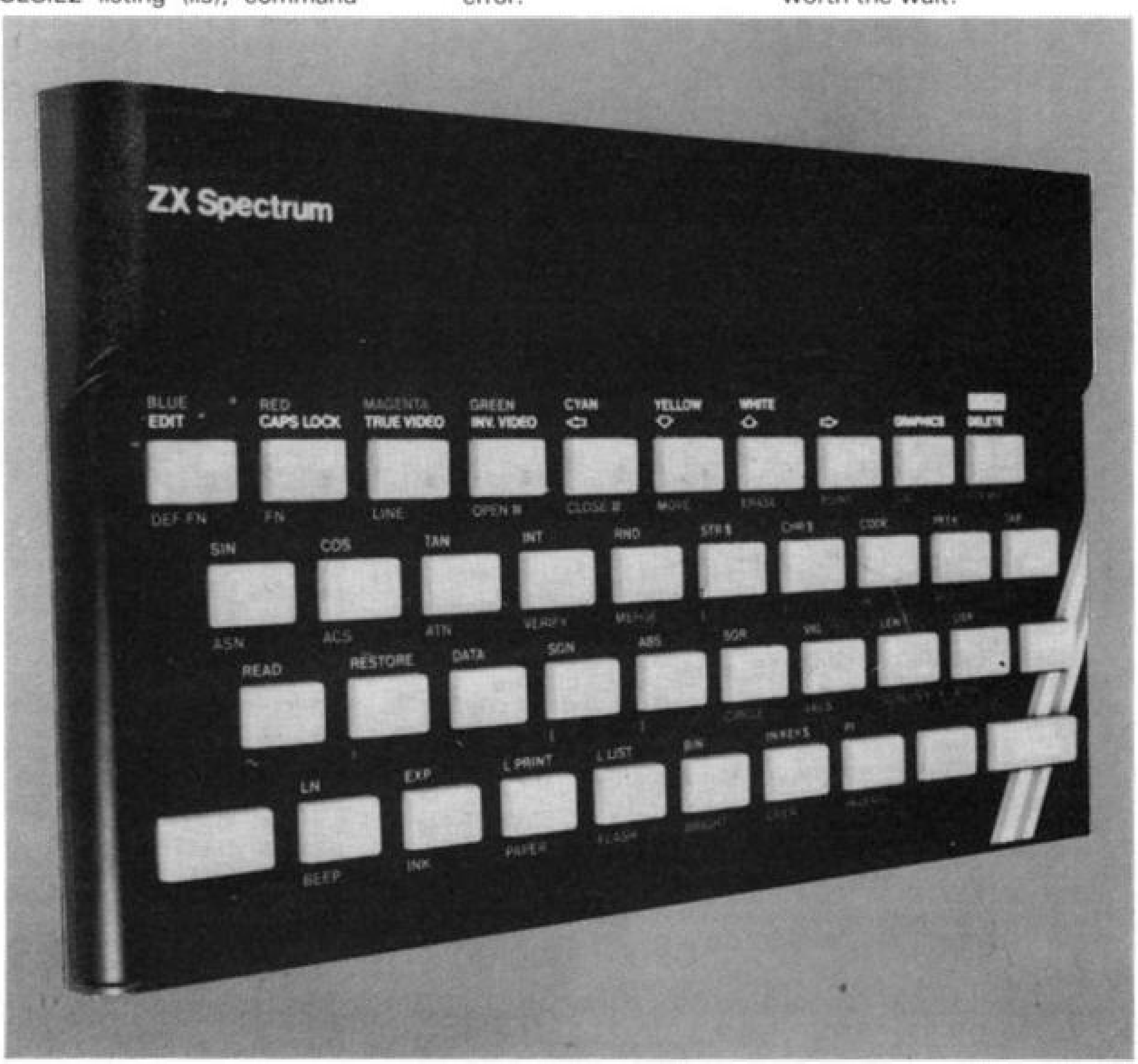
Errors

ZX-CESIL2 generates error messages for various user errors. The possible error/report messages are:

(i) Data all used.
(ii) List complete.
(iii) Illegal label error.
(iv) Instruction does not exist.
(v) Command as statement error.
(vi) Illegal use of argument error.
(vii) Space missing error.
(viii) Label missing error.
(ix) Illegal operand.
(x) Number out of range error.
(xi) Location missing.
(xii) Invalid location.
(xiii) Missing quote error.
(xiv) Invalid text error.
(xv) What?
(xvi) Statement as command error.
(xvii) No more program room.
(xviii) Data invalid.
(xix) First 20 items of data only accepted.
(xx) No hal instruction.
(xxi) Last line reached or hal executed.
(xxii) Called label does not exist.
(xxiii) Arithmetic overflow.

Part two...

Due to the length of this listing, it was decided to run the article over two issues. The second part of this feature will contain the remainder of the listing, as well as some screen dumps of the program in action. Our apologies for the inconvenience and our hope that you find it worth the wait.



```
  10 REM ##Set up variables etc.
  20 DIM a$(99,2): DIM c$(20,3):
 DIM d$(20,2): DIM j$(31): DIM k
$(25): DIM l$(99): DIM p$(100,25
): DIM c(20): DIM l(20)
  30 DATA "add",1100,"beg",1,"ch
a",200,"del",201,"div",1101,"hal
",1002,"in ",1003,"jin",1300,"ji
z",1301,"jum",1302,"kin",1004,"l
in",1005,"lis",6,"loa",1102,"mul
",1103,"new",7,"out",1008,"pri",
1400,"sto",1500,"sub",1104
  40 FOR c=1 TO 20
  50 READ c$(c),c(c)
  60 NEXT c
  70 LET b$="": LET xpos=0
  75 FOR c=1 TO 20: READ l(c): N
EXT c
  80 FOR c=1 TO 99: LET l$(c)=CH
R$ 0: NEXT c
  90 LET acc=0
 100 LET mode=1
 110 DATA 720,4150,2120,1980,760
,810,830,1940,1900,1860,930,970,
1350,1010,1050,1090,1110,1150,12
40,1310
 120 LET w$=""
 130 LET cn=0
 140 LET cline=0
 150 LET dp=0
 160 LET y$=""
 170 LET r$=CHR$ 13
 175 REM Line numbers for subs.
 180 LET labelfn=4370
 190 LET textprint=3330
 200 LET cmode=3460
 210 LET incheck=3220
 220 LET fetchno=3070
 230 LET overflow=3160
 240 LET next=4300
 250 LET break=3300
 260 LET syncheck=2260
 270 LET error=3020
 280 LET input=3410
 290 LET xx=0
 295 REM Flags
 300 LET valid=0
 310 LET bad=0
 320 LET lab=0
 325 REM General variables
 330 LET z=0
 340 LET n=0
 350 LET c=0
 360 LET x=0
 370 LET i$=""
 380 LET n$=""
 390 LET lastln=1
 400 LET item=0
 410 LET litm=0
 420 LET t$=""
 430 LET b=0
 440 REM ##End initialisation
 450 BORDER 2: INK 0: PAPER 7: C
LS
 460 PRINT INK 2;"           ZX-
"; INK 0;"CESIL"; INK 1;"2"
 470 PRINT "
"
 480 PRINT '"This program allows
 the user to"
 490 PRINT '"speak to the comput
er in "; INK 1;"CESIL"; INK 0;".
"
 500 PRINT '"The version of CESI
L used is"
 510 PRINT ' INK 2;"ZX-"; INK 0;
"CESIL"; INK 1;"2.4"; INK 0;" &
is unique to the"
 520 PRINT '"Sinclair ZX Spectru
m with 16K"
 530 PRINT '"BASIC in ROM and 48
K RAM."
 540 PRINT AT 21,10; FLASH 1; IN
K 1;"Press any key"
 550 IF INKEY$="" THEN GO TO 550
 560 CLS : PRINT "The commands s
upported are:"
 570 PRINT " beg,cha,del,lis,new
,ter,*(start"
 580 PRINT "program entry.'ter'
returns you to BASIC)"
 590 PRINT '"The statements supp
orted are:"
 600 PRINT " add,div,hal,in,jin,
jiz,jum,kin,"
 610 PRINT " lin,loa,mul,out,pri
,sto,sub,;"
 620 PRINT "(comment marker)"
 630 PRINT '"See text for explan
ation of       all these & rules t
o be obeyed."
 640 PRINT '"All numbers are int
egers between-32767 and +32767 (
inclusive)."
 650 PRINT '"Store locations are
 a1 to a99 & labels are l1 to l9
9."
 660 PRINT '"100 CESIL lines may
 be stored."
 670 PRINT AT 21,10; FLASH 1; IN
K 1;"Press any key"
 680 IF INKEY$="" THEN GO TO 680
 690 CLS
 700 PRINT "Welcome to ZX-"; INK
 0;"CESIL"; INK 1;"2"; INK 0;" ©
J.Miller"
 710 GO TO cmode
 715 REM Lines 720-2250 are the
          implementation S/Rs
 720 REM ##add
 730 GO SUB fetchno
 740 LET acc=acc+z
 750 GO TO overflow
 760 REM ##div
 770 GO SUB fetchno
 780 IF NOT z THEN GO TO 3190
 790 LET acc=INT (acc/z)
 800 GO TO next
 810 REM ##hal
 820 GO TO 4340
 830 REM ##in
 840 IF dp<item+1 THEN GO TO 880
 850 LET w$="Data all used."+r$
 860 GO SUB textprint
 870 GO TO cmode
 880 LET z=CODE d$(dp,1)*256+COD
E d$(dp,2)
 890 IF z>32767 THEN LET z=z-655
36
 900 LET acc=z
 910 LET dp=dp+1
 920 GO TO next
 930 REM ##kin
 940 GO SUB input
 950 LET acc=VAL i$
 960 GO TO next
 970 REM ##lin
 980 LET w$=r$
 990 GO SUB textprint
1000 GO TO next
1010 REM ##loa
1020 GO SUB fetchno
1030 LET acc=z
1040 GO TO next
1050 REM ##mul
1060 GO SUB fetchno
1070 LET acc=acc*z
1080 GO TO overflow
1090 REM ##new
1100 RUN 10
1110 REM ##out
1120 LET w$=" "+STR$ acc+" "
1130 GO SUB textprint
1140 GO TO next
1150 REM ##pri
1155 REM Find text,isolate and
          output it.
1160 LET w$=p$(cline,3 TO )
1170 FOR c=1 TO 23
1180 IF w$(c)=r$ THEN LET w$=w$(
```

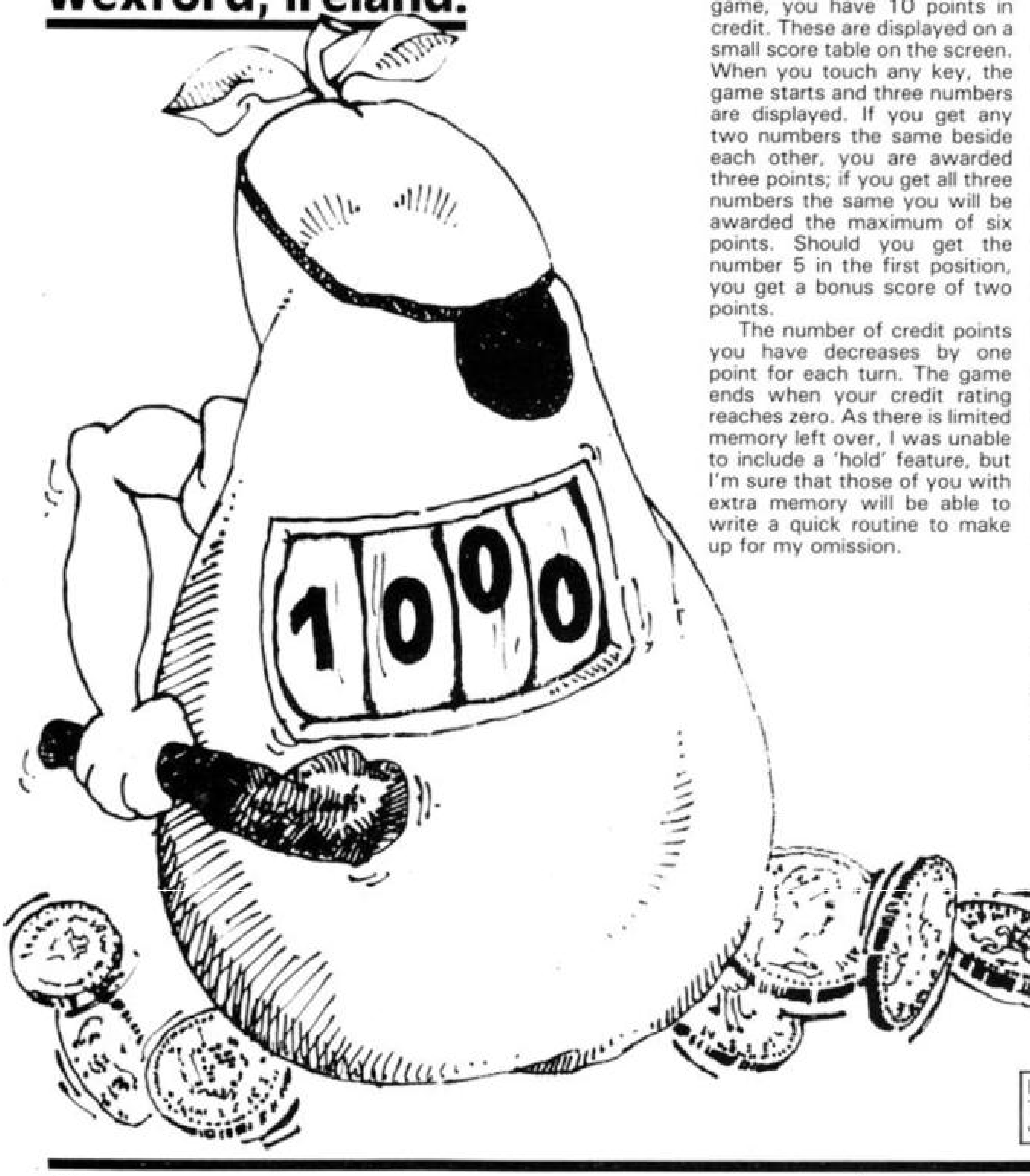
```
TO c)
1190 IF LEN w$=c THEN GO TO 1210
1200 NEXT c
1210 LET w$=w$( TO LEN w$-1)
1220 GO SUB textprint
1230 GO TO next
1240 REM ##sto
1250 LET z=CODE p$(cline,3)
1260 LET acc2=acc
1270 IF acc2<0 THEN LET acc2=acc
2+65536
1280 LET a$(z,1)=CHR$ INT (acc2/
256)
1290 LET a$(z,2)=CHR$ INT (acc2-
(256*INT (acc2/256)))
1300 GO TO next
1310 REM ##sub
1320 GO SUB fetchno
1330 LET acc=acc-z
1340 GO TO overflow
1350 REM ##lis
1355 REM Start a new page
1360 LET xpos=0
1370 CLS
1380 FOR x=1 TO 100
1390 IF p$(x,2)<>";" THEN GO TO
1430: REM Not a comment?
1400 LET w$=p$(x)+r$
1410 GO SUB textprint
1420 GO TO 1790
1430 IF p$(x,1)=" " THEN GO TO 1
460: REM A labelled line?
1440 LET w$="l"+STR$ CODE p$(x)
1450 GO SUB textprint
1460 IF x=lastln THEN GO TO 1810
: REM End of program?
1465 REM Work out instruction
1470 LET n=c(CODE p$(x,2))
1480 LET n=INT (INT (n-(INT (n/1
e3)*1e3))/100)
1490 LET xpos=4
1500 LET w$=c$(CODE p$(x,2))
1510 GO SUB textprint
1520 IF n<>4 THEN GO TO 1610
1525 REM Is pri.
1530 LET i$=p$(x,3 TO )
1540 LET w$=" """"
1550 FOR z=1 TO 23
1560 IF i$(z)=r$ THEN LET i$(z)=
""""
1570 NEXT z
1580 LET w$=w$+i$+r$
1590 GO SUB textprint
1600 GO TO 1790
1610 IF n<>0 THEN GO TO 1650
1615 REM Is hal,in,kin,lin or
        out.
1620 LET w$=r$
1630 GO SUB textprint
1640 GO TO 1790
1650 IF n<>1 THEN GO TO 1720
1655 REM Is add,div,loa,mul or
        sub.
1660 LET w$=p$(x,3)
1670 LET z=CODE p$(x,4)*256+CODE
 p$(x,5)
1680 IF z>32767 THEN LET z=z-655
36
1690 LET w$=" "+w$+STR$ z+r$
1700 GO SUB textprint
1710 GO TO 1790
1720 IF n<>3 THEN GO TO 1760
1725 REM Is jin,jiz or jum.
1730 LET w$=" l"+STR$ CODE p$(x,
3)+r$
1740 GO SUB textprint
1750 GO TO 1790
1760 IF n<>5 THEN GO TO 1790
1765 REM Is sto.
1770 LET w$=" a"+STR$ CODE p$(x,
3)+r$
1780 GO SUB textprint
1790 GO SUB break
1800 NEXT x
1805 REM Output data string.
1810 LET w$=t$+r$+r$
1820 GO SUB textprint
1830 LET w$="List complete"+r$
1840 GO SUB textprint
1850 GO TO cmode
1860 REM ##jum
1870 GO SUB labelfn
1880 LET cline=z-1
1890 GO TO next
1900 REM ##jiz
1910 GO SUB labelfn
1920 IF acc=0 THEN LET cline=z-1
1930 GO TO next
1940 REM ##jin
1950 GO SUB labelfn
1960 IF acc<0 THEN LET cline=z-1
1970 GO TO next
1980 REM ##del
1990 LET w$="Which line?"+r$
2000 GO SUB textprint
2010 GO SUB input
2020 IF VAL i$<1 OR VAL i$>lastl
n THEN GO TO 2010
2025 REM Shift all lines follow-
        ing that deleted down 1
2030 FOR z=VAL i$+1 TO 100
2040 LET p$(z-1)=p$(z)
2050 NEXT z
2060 LET lastln=lastln-1
2065 REM Adjust label dictionary
2070 FOR z=1 TO 99
2080 IF CODE l$(z)=VAL i$ THEN L
ET l$(z)=CHR$ 0
2090 IF CODE l$(z)>VAL i$ THEN L
ET l$(z)=CHR$ (CODE l$(z)-1)
2100 NEXT z
2110 GO TO cmode
2120 REM ##cha
2130 LET w$="Change line?"+r$
2140 GO SUB textprint
2150 GO SUB input
2160 IF VAL i$<1 OR VAL i$>lastl
n THEN GO TO 2150
2170 LET w$="Change line "+i$+"
to?"+r$
2180 GO SUB textprint
2190 INPUT LINE j$
2200 LET x=VAL i$
2210 GO SUB syncheck
2220 IF bad THEN GO TO 2170
2230 LET p$(x)=k$: REM Store new
                   line.
2240 IF lab THEN LET l$(lab)=CHR
$ x: REM lab=1 means labelled
        line.
2250 GO TO cmode
2260 REM ##syncheck
2270 DIM k$(25)
2275 REM Reset flags
2280 LET bad=0
2290 LET lab=0
2300 IF LEN j$<3 THEN GO TO 2460
2305 REM If line has a valid lab
el then 2330
2310 IF j$(1)="l" AND j$(2)>="0"
 AND j$(2)<="9" AND (j$(3)>="0"
AND j$(3)<="9" OR j$(3)=" ") THE
N GO TO 2330
2320 GO TO 2390
2330 LET lab=VAL j$(2 TO 3)
2340 IF lab<1 OR lab>99 THEN GO
TO 2380: REM Label invalid
2350 LET k$(1)=CHR$ lab
2360 LET j$=j$(5 TO )
2370 GO TO 2390
```

To be continued...

The remainder of this listing will be included in the June/July issue of ZX Computing.

Number tumbler

Your number's up with this program from Mark Burke from County Wexford, Ireland.



Written for the unexpanded ZX81, this program is a version of the old favourite 'Fruit machine'. However, in this program, instead of designs, bars, apples, etc, you use numbers.

At the beginning of the game, you have 10 points in credit. These are displayed on a small score table on the screen. When you touch any key, the game starts and three numbers are displayed. If you get any two numbers the same beside each other, you are awarded three points; if you get all three numbers the same you will be awarded the maximum of six points. Should you get the number 5 in the first position, you get a bonus score of two points.

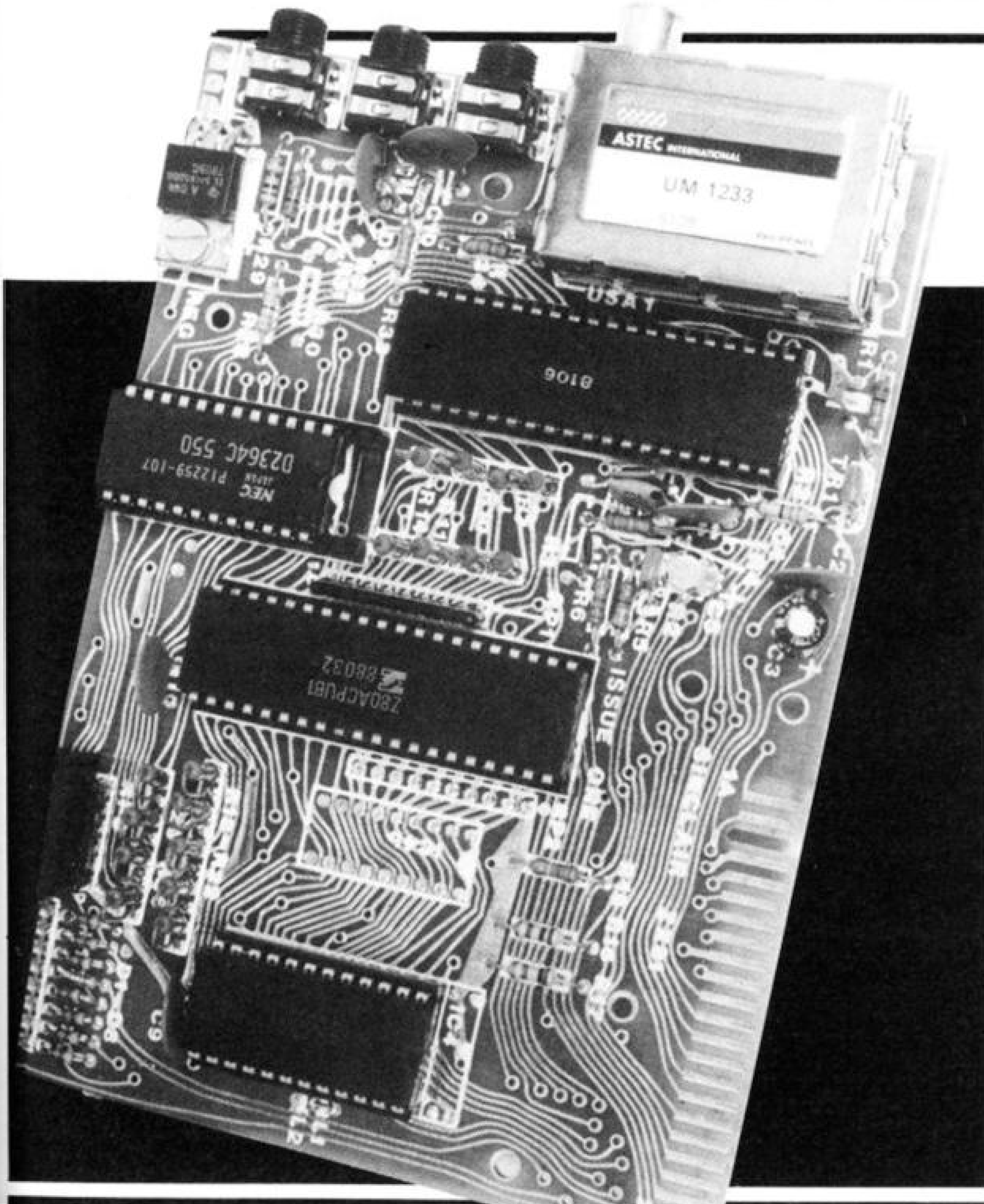
The number of credit points you have decreases by one point for each turn. The game ends when your credit rating reaches zero. As there is limited memory left over, I was unable to include a 'hold' feature, but I'm sure that those of you with extra memory will be able to write a quick routine to make up for my omission.

```
2   LET CR=VAL"10"
35  LET CR=CR-VAL"1"
37  PRINT "SCORE TABLE"
38  PRINT
40  PRINT "5 - - = 2
    POINTS"
50  PRINT "2 EQUAL
    NUMBERS TOGETHER
    = 3 POINTS"
60  PRINT "ALL THREE THE
    SAME = 6 POINTS"
80  PRINT
85  PRINT "CREDITS =
    ";CR
86  LET X=INT(RND*VAL
    "10")
87  LET Y=INT(RND*VAL
    "10")
88  LET Z=INT(RND*VAL
    "10")
90  PRINT "■■■■■■■■
    ■■■■■■■■"
94  PRINT "■ ";X;"■ ";Y;
    "■ ";Z;"■ "
96  PRINT "■■■■■■■■
    ■■■■■■■■"
98  IF X=VAL "5" AND
    Y<>X THEN LET
    CR=CR+VAL"2"
99  IF X=Y AND Y=Z
    THEN LET
    CR=CR+VAL"6"
100 IF X=Y AND Z<>X OR
    X<>Y AND Y=Z THEN
    LET CR=CR+VAL"3"
105 IF CR=PI - PI THEN
    GOTO VAL"130"
107 PRINT "TOUCH ANY
    KEY"
110 PAUSE 4E4
115 CLS
120 GOTO VAL"35"
130 PRINT "FINISHED - NO
    CREDITS LEFT"
```

Note that the message 'SCORE TABLE' in line 37 should be in inverse video for maximum effect.

Circuit sketch

Here's a program from GL Maynard of Gosport for those of you who fancy a spot of electronic circuit training.



This incredible program will allow Spectrum users to make full use of their machine's high resolution graphics to form diagrams of electronic apparatus and either SAVE the results on tape or PRINT them out on the ZX Printer. An example of the resolution possible with this listing is shown in Fig. 1, an outdated radio circuit.

Drawing on experience

When RUN, the user will be asked to type in the numbers corresponding to the INK and PAPER colours required. An initial point will also be asked for; this is the point from which the sketch is to begin from.

The drawing of the circuit can then begin. To draw the components, the key corresponding to the first letter of the component should be pressed. The following represents a list of components included in the program:

Non-polarised capacitor	— 'c'
Variable capacitor	— 'c'
Electrolytic capacitor	— 'c'
Fixed resistor	— 'r'
Variable resistor	— 'r'
PNP transistor	— 't'
Diode	— 'd'
Inductor	— 'i'
Switch	— 's'
Battery	— 'b'
Fuse	— 'f'

Other components could easily be added should you require them.

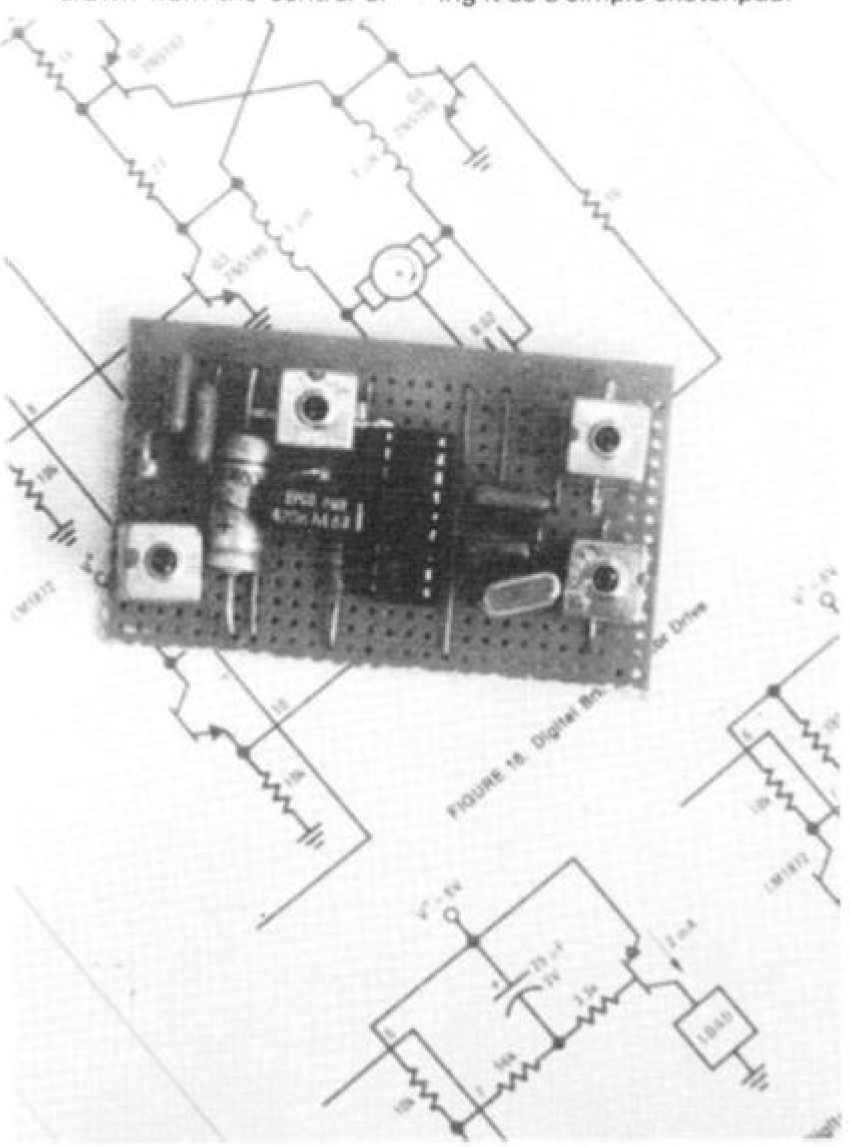
Once you have pressed a certain key, the computer requires other information as to the nature of the component. For

example, information must be given as to whether it is to be drawn vertically or horizontally; whether it should be drawn from the positive or negative end; whether a resistor is variable or fixed, etc. Once a component has been drawn, you can draw the interlinking lines using the cursor keys, '5', '6', '7' and '8' to draw a line left, down, up or right respectively. The computer will automatically allow you to start drawing from the other side of the component, or in the case of a transistor, from the collector.

Going up . . .

Components may be drawn horizontally or vertically (except the transistor), but the following rules must be noted:

1 – Horizontal components are drawn left to right.
2 – Vertical components are drawn from the bottom to the top.
3 – If you are drawing from left to right, the component must be horizontal.
4 – Transistors are drawn horizontal, beginning at the base and ending up at the collector.
5 – Variable components are drawn from the central arrow position and terminate at the right or top end.



The current plotting position is always displayed; if you want to draw accurately or PRINT in component numbers or values at a later stage, you would be wise to note down the position of each component.

You may not draw off the screen; you will be stopped by the contents of line 64. However, you are allowed to change the plotting position by pressing the 'p' key and stating the co-ordinates of the new position. The variable screen is set to zero if further drawing will result in the line going off the screen.

Once the circuit has been completed, you can press the Break key and, using PRINT, mark in any additional script onto the diagram. Should you wish to SAVE the program, try using the following:

SAVE "circuits" LINE 2

This will allow the program to RUN automatically when reLOADed.

Should the thought of playing around with electronic circuits scare you to death, try using it as a simple sketchpad.

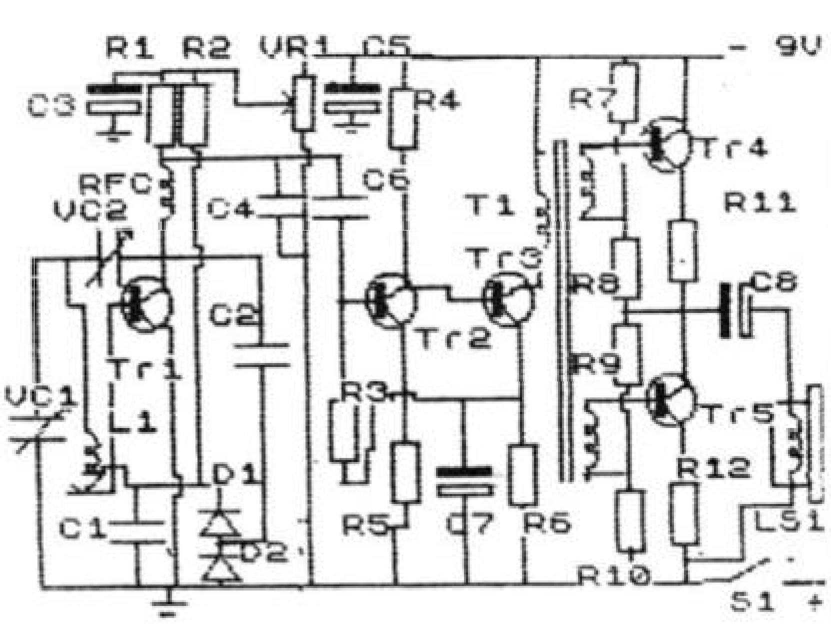


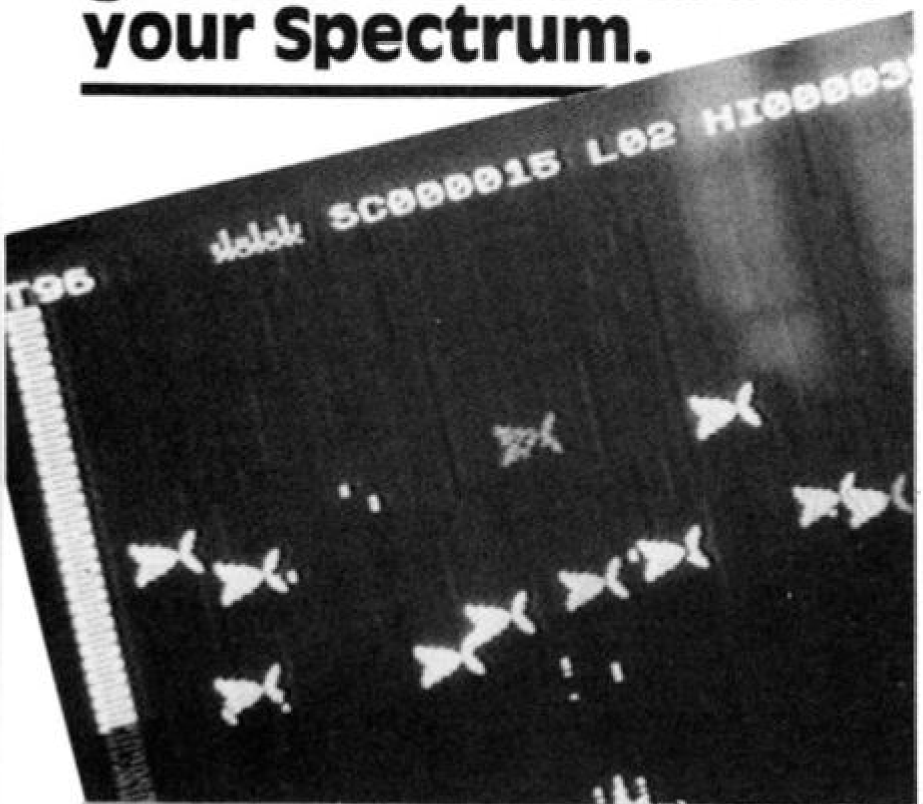
Fig. 1. An example of the resolution available with this program. This circuit sketch is of an outdated radio circuit.

```
   1 REM CIRCUIT_DIAGRAM SKETCH
   2 INPUT "paper?";paper;"ink?"
;ink: INPUT AT 2,0;"initial plot
 position? x -";x;" Y- ";y
   3 GO SUB 8000
   4 PAPER paper: CLS : INK ink
   5 PLOT x,y
   6 LET screen=1
   8 PRINT AT 0,0;0;" , ";0
  10 LET m$=""
  15 LET m$=INKEY$
  30 IF m$>="5" AND m$<="8" THEN
 RESTORE (VAL m$-3)*100
  46 IF m$>="5" AND m$<="8" THEN
 GO TO 60
  50 RESTORE 55: FOR z=1 TO 10:
READ u$,u: IF u$=m$ THEN GO TO u
  52 NEXT z
  55 DATA "f",6500,"b",5500,"s",
6000,"i",3500,"p",1000,"",10,"c"
,2000,"r",2500,"t",3000,"d",4000
  60 READ a,b
  62 IF screen=0 THEN GO TO 64
  64 IF x=255 AND m$="8" OR x=0
AND m$="5" OR y=175 AND m$="7" O
R y=0 AND m$="6" THEN LET screen
=0: GO TO 10
  65 LET x=x+a
  67 LET y=y+b
  68 PRINT OVER 0;AT 0,0;"
"
  69 PRINT OVER 0;AT 0,0;x;" , "
;y
  70 DRAW a,b
  75 LET screen=1
  80 GO TO 10
 200 DATA -1,0
 300 DATA 0,-1
 400 DATA 0,1
 500 DATA 1,0
1000 INPUT "X - co-ordinate?";x
1005 INPUT "Y - co-ordinate";y
1010 PLOT x,y: GO TO 10
2005 INPUT "h or v";k$: GO SUB 8
000
2007 INPUT "electrolytic? (Y/N)"
;z$: GO SUB 8000: IF z$="y" THEN
 GO TO 2100
2010 INPUT "variable? (Y/N)";z$:
```

```
 GO SUB 8000: IF z$="y" THEN GO
TO 2050
2015 IF k$="h" THEN DRAW 0,8: DR
AW 0,-16: LET x=x+6: LET y=y-8:
PLOT x,y: DRAW 0,16: DRAW 0,-8:
LET y=y+8: GO TO 10
2020 IF k$="v" THEN DRAW -8,0: D
RAW 16,0: LET y=y+6: LET x=x+8:
PLOT x,y: DRAW -16,0: DRAW 8,0:
LET x=x-8: GO TO 10
2050 IF k$="h" THEN PLOT x-4,y-8
: DRAW 14,16: DRAW 0,-2: DRAW 0,
2: DRAW -2,0: DRAW 2,0: PLOT x,y
: GO TO 2015
2060 IF k$="v" THEN PLOT x-6,y-4
: DRAW 16,14: DRAW -2,0: DRAW 2,
0: DRAW 0,-2: DRAW 0,2: PLOT x,y
: GO TO 2020
2100 INPUT "pos or neg first?";z
$: GO SUB 8000
2110 IF k$="v" AND z$="pos" THEN
 DRAW 8,0: DRAW -16,0: DRAW 0,3:
 DRAW 16,0: DRAW 0,-3: PLOT x,y+
6: DRAW -8,0: DRAW 16,0: DRAW 0,
1: DRAW -16,0: DRAW 0,1: DRAW 16
,0: DRAW -8,0: LET y=y+9: GO TO
10
2120 IF k$="v" AND z$="neg" THEN
 DRAW 8,0: DRAW -16,0: DRAW 0,1:
 DRAW 16,0: DRAW 0,1: DRAW -16,0
: PLOT x,y+6: DRAW -8,0: DRAW 16
,0: DRAW 0,3: DRAW -16,0: DRAW 0
,-3: DRAW 0,3: DRAW 8,0: LET y=y
+9: GO TO 10
2130 IF k$="h" AND z$="pos" THEN
 DRAW 0,8: DRAW 0,-16: DRAW 3,0:
 DRAW 0,16: DRAW -3,0: PLOT x+6,
y: DRAW 0,8: DRAW 0,-16: DRAW 1,
0: DRAW 0,16: DRAW 1,0: DRAW 0,-
16: DRAW 0,8: LET x=x+9: GO TO 1
0
2140 IF k$="h" AND z$="neg" THEN
 DRAW 0,8: DRAW 0,-16: DRAW 1,0:
 DRAW 0,16: DRAW 1,0: DRAW 0,-16
: PLOT x+6,y: DRAW 0,8: DRAW 0,-
16: DRAW 3,0: DRAW 0,16: DRAW -3
,0: DRAW 3,0: DRAW 0,-8: LET x=x
+9: GO TO 10
2500 INPUT "h or v?";k$: GO SUB
8000
2505 INPUT "variable ? (Y/N)";z$
: GO SUB 8000
2506 IF z$="y" THEN GO TO 2700
2510 IF k$="h" THEN DRAW 0,4: DR
AW 18,0: DRAW 0,-8: DRAW -18,0:
DRAW 0,4: DRAW 0,-4: DRAW 18,0:
DRAW 0,4: LET x=x+18: GO TO 10
2520 IF k$="v" THEN DRAW 4,0: DR
AW 0,18: DRAW -8,0: DRAW 0,-18:
DRAW 4,0: DRAW -4,0: DRAW 0,18:
DRAW 4,0: LET y=y+18: GO TO 10
2700 IF k$="h" THEN DRAW -3,3: D
RAW 3,-3: DRAW -3,-3: DRAW 3,3:
DRAW 0,8: DRAW 0,-16: DRAW 6,0:
DRAW 0,16: DRAW -6,0: DRAW 3,0:
LET y=y+8: LET x=x+3: GO TO 10
2720 IF k$="v" THEN DRAW -3,-3:
DRAW 3,3: DRAW 3,-3: DRAW -3,3:
DRAW 8,0: DRAW -16,0: DRAW 0,6:
DRAW 16,0: DRAW 0,-6: DRAW 0,3:
LET x=x+8: LET y=y+3: GO TO 10
3000 INPUT "pnp or npn";z$: GO S
UB 8000
3010 IF z$="npn" THEN CIRCLE x+6
,y,8: PLOT x,y: DRAW 2,0: DRAW 0
,5: DRAW 0,-10: DRAW 1,0: DRAW 0
,10: DRAW 1,0: DRAW 0,-10: DRAW
0,3: DRAW 4,-4: DRAW 0,1: DRAW 0
,-1: DRAW -1,0: DRAW 1,0: DRAW -
4,4: DRAW 0,2: DRAW 6,4: LET x=x
+10: LET y=y+4: GO TO 10
3020 IF z$="pnp" THEN CIRCLE x+6
,y,8: PLOT x,y: DRAW 2,0: DRAW 0
,5: DRAW 0,-10: DRAW 1,0: DRAW 0
,10: DRAW 1,0: DRAW 0,-10: DRAW
0,3: DRAW 4,-4: DRAW -4,4: DRAW
1,0: DRAW -1,0: DRAW 0,-1: DRAW
0,1: DRAW 0,2: DRAW 6,4: LET x=x
+10: LET y=y+4: GO TO 10
3500 INPUT "h or v";z$: GO SUB 8
000
3510 IF z$="h" THEN DRAW 2,0: DR
AW 7,0,PI: DRAW -2,0: DRAW 7,0,P
I: DRAW -2,0: DRAW 7,0,PI: DRAW
2,0: LET x=x+21: GO TO 10
3520 IF z$="v" THEN DRAW 0,2: DR
AW 0,7,PI: DRAW 0,-2: DRAW 0,7,P
I: DRAW 0,-2: DRAW 0,7,PI: DRAW
0,2: LET y=y+21: GO TO 10
4000 INPUT "h or v?";z$: GO SUB
8000
4010 INPUT AT 0,0;"cathode (c) o
r anode (a) first?";k$: GO SUB 8
000
4020 IF z$="h" AND k$="c" THEN D
RAW 0,6: DRAW 0,-12: DRAW 0,6: D
RAW 7,-6: DRAW 0,12: DRAW -7,-6:
 DRAW 7,6: DRAW 0,-6: LET x=x+7:
 GO TO 10
4000 IF z$="h" AND k$="a" THEN D
RAW 0,6: DRAW 0,-12: DRAW 7,6: D
RAW -7,6: DRAW 7,-6: DRAW 0,6: D
RAW 0,-12: DRAW 0,6: LET x=x+7:
GO TO 10
4040 IF z$="v" AND k$="c" THEN D
RAW 6,0: DRAW -12,0: DRAW 6,0: D
RAW -6,7: DRAW 12,0: DRAW -6,-7:
 DRAW 6,7: DRAW -6,0: LET y=y+7:
 GO TO 10
4050 IF z$="v" AND k$="a" THEN D
RAW 6,0: DRAW -12,0: DRAW 6,7: D
RAW 6,-7: DRAW -6,7: DRAW -6,0:
DRAW 12,0: DRAW -6,0: LET y=y+7:
 GO TO 10
5500 INPUT "h or v";z$: GO SUB 8
000
5510 INPUT "pos or neg first";k$
: GO SUB 8000
5520 IF z$="v" AND k$="pos" THEN
 DRAW -7,0: DRAW 14,0: PLOT x,y+
3: DRAW 3,0: DRAW -6,0: DRAW 3,0
: LET y=y+3: GO TO 10
5530 IF z$="v" AND k$="neg" THEN
 DRAW 3,0: DRAW -6,0: PLOT x,y+3
: DRAW -7,0: DRAW 14,0: DRAW -7,
0: LET y=y+3: GO TO 10
5540 IF z$="h" AND k$="pos" THEN
 DRAW 0,7: DRAW 0,-14: PLOT x+3,
y: DRAW 0,3: DRAW 0,-6: DRAW 0,3
: LET x=x+3: GO TO 10
5550 IF z$="h" AND k$="neg" THEN
 DRAW 0,3: DRAW 0,-6: PLOT x+3,y
: DRAW 0,-7: DRAW 0,14: DRAW 0,-
7: LET x=x+3: GO TO 10
6000 INPUT "h or v?";k$: GO SUB
8000
6010 IF k$="h" THEN DRAW 14,7: L
ET x=x+14: PLOT x,y: GO TO 10
6020 IF k$="v" THEN DRAW 7,14: L
ET y=y+14: PLOT x,y: GO TO 10
6500 INPUT "h orv?";k$: GO SUB 8
000
6510 IF k$="h" THEN DRAW 0,4: DR
AW 0,-8: DRAW 1,0: DRAW 0,8: DRA
W 1,0: DRAW 0,-8: DRAW 1,0: DRAW
 0,8: DRAW 10,0: DRAW 0,-8: DRAW
 -10,0: DRAW 10,0: DRAW 0,4: LET
 x=x+13: GO TO 10
6520 IF k$="v" THEN DRAW 4,0: DR
AW -8,0: DRAW 0,1: DRAW 8,0: DRA
W 0,1: DRAW -8,0: DRAW 0,1: DRAW
 8,0: DRAW 0,10: DRAW -8,0: DRAW
 0,-10: DRAW 0,10: DRAW 4,0: LET
 y=y+13: GO TO 10
8000 FOR z=1 TO 7: NEXT z: RETUR
N
```

It's all a game . . .

James Walsh looks at some of the latest and greatest software for your Spectrum.



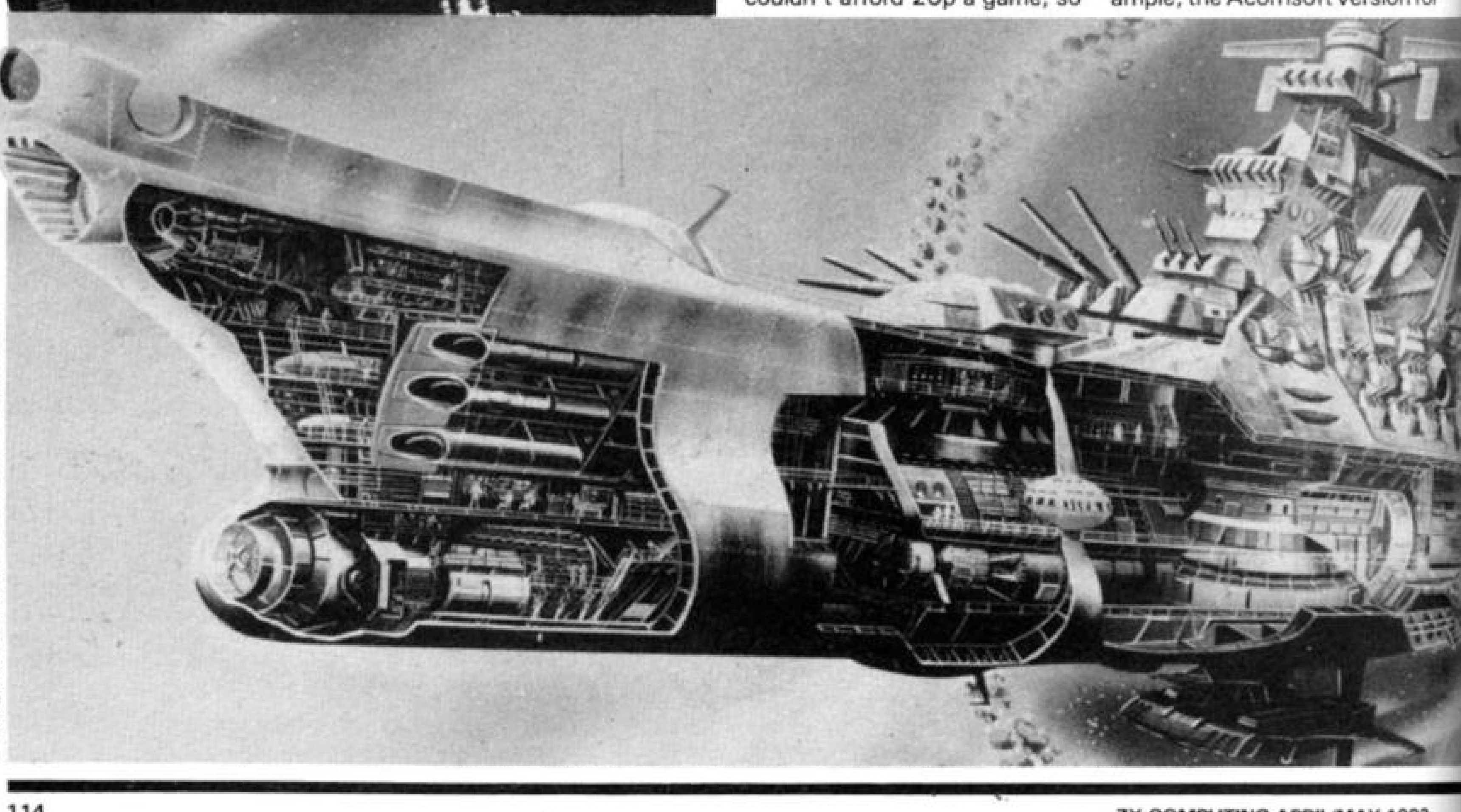
Games form the major portion of the software available for the Spectrum, so there is likely to be a pretty good choice available. But as with any market, there is the good and the bad. Though it is not difficult to differentiate when you're playing them on a computer, when they are staring at you from the pages of a glossy computer magazine, or sitting on the shelves of W.H. Smiths, then the choice is far more difficult. There are now the established producers of top quality software, such as Quicksilva and Artic, who can be relied upon to bring out good software. However, various new companies are now coming into the market with new and often exciting programs, some of them having the financial backing to compete with the Quicksilvas of this world and the market is definitely opening up at an alarming rate. For these reasons I am delighted to have new packages from one of my favourites, Artic, a new company, Imagine, and Computer Rental Limited.

Gobbleman — Artic Computing

Have you guessed what this title really means? Yes, it is Artic's version of the well-known 'Pac-Man' game. Pac-Man is so well known now, that in a few years time it will probably be thought of as part of computer heritage: . . . In the beginning there were Space Invaders and Pac-Man, but the poor boys and girls couldn't afford 20p a game, so they invented the home computer . . . But we all know that that is wrong . . . E.T. invented them, that's what he wanted to phone home about!

Back to the serious stuff now and as the old saying goes: When you have seen one Pac-Man, you have seen 'em all. As far as Gobbleman is concerned, this view holds true. Visually, it is very similar indeed to the original, with the same features such as pills, etc, but a slightly better maze, in that it is bigger. Overall, it is quite a pleasing display, except for two annoying points: the words 'ARTIC Computing' pulsating at you all the time you are playing certainly does become irritating, and also when the ghosts eat you, instead of a decent explosion or a picture of a Gobbled Man (get it?), it simply runs through part of the character set at that point — surely they could not have been that short of memory? The speed of the response is very good, and the tempo of the game has been well-selected — it has to be when there is only one level of play! The ghosts are highly intelligent, and actually remember to run away from you when you have just eaten a pill. Unfortunately, they are the same speed as you, so they are rather difficult to catch up with at times, which seems rather illogical.

As far as being a Pac-Man copy it is good, so it is great for the Pac-Man enthusiast. But where it loses out is in that it is totally unadventurous. For example, the Acornsoft version for



Photograph courtesy of Enterprise Pictures Ltd.

the BBC adds extra functions, and Gulpman from Campbell Systems Ltd actually expands on the game with variable speeds and tempo, and an enormous number of different mazes, plus a new laser feature. So, if you are looking for a near perfect copy of the original Pac-Man then Gobbleman is definitely worth considering, but for something more challenging I would recommend Gulpman.

Gobbleman is available at £4.95 from Artic Computing, 396 James Reckitt Avenue, Hull HU8 OJA.

Gulpman is available at £5.95 from Campbell Systems Ltd, 15 Rous Road, Buckhurst Hill, Essex.

Arcadia — Imagine Software

If you had told me back in late November that a company called Imagine had come up with an amazing new game, then my reaction would probably have been 'Who?'. By the time that this review is published, Imagine should be competing more than favourably with giants such as Quicksilva for the title of creators of the 'ultimate game'. The three wise men of Imagine, DH Lawson, Eugene Evans and Mark Butler, obviously don't believe in coming quietly onto the market — but with the advertising campaign that they have recently launched, they can only be described as having exploded onto the market! Sometimes when you see a really amazing advert, you wonder whether the software can possibly be as good as it claims, but in this case, they may well be justified. Imagine can be quoted as saying that they have only one real aim — to be the BEST!!! At the moment they seem to be going about it in exactly the right way.

To describe accurately a game which relies on some of the best two-dimensional graphics around is far from easy, but the wording used in the advert is quite apt: 'The fastest, meanest, most addictive shoot 'em up game you've ever desired!' Arcadia, which is written totally in machine code, and will fit in both the 16K and 48K versions of the Spectrum, is, if you break it down, really a third generation invaders. The basic idea is the same in that you gain points by killing off the aliens, but you can also blast yourself off from the bottom of the screen and then let yourself glide back down again when you release the pressure. You also have two Plasma Disruptors instead of the one meagre gun that is found in more basic versions. The functions of the keyboard have been laid out very nicely — on the bottom row each key is either move left or right; all the keys on the second row are thrust and all the keys on the third row are fire, whilst pressing a key on the top row causes the game to HOLD.

The first thing that happens is that a high-resolution picture of the Imagine logo drifts down the screen before the name Arcadia is drawn. It will then ask you to press any key to start and you are then thrust straight into the game itself. The idea of the game is to survive the particular race of aliens long enough for the counter in the top left of the screen to reach zero. This usually entails killing off just enough to keep yourself safe when the counter gets near zero and the aliens become suicidal. If you kill them all off, a new wave of the same race appears, whilst if you survive long enough a new race of aliens attacks you. The different sets of alien are quite bizarre and amazing. They range from defender-like characters, to seagulls, to little space men, to pulsating blobs and asteroids . . . the list goes on. The graphics are amazingly smooth and precise, with an extensive use of colour and sound. The game has a highest score display though you can't type your own name in, which is a shame. But remember that most of the really amazing games, such as Time-Gate, only fit into the 48K machine, whilst Arcadia will run in the 16K or 48K . . . a feat in itself.

Arcade addict

Arcadia is highly addictive and very well presented, though the instructions could have been mildly improved upon. But at only £5.50, it is fantastic value for money. Imagine also offer an unconditional lifetime guarantee — if an Imagine software product ever fails to load first time, simply return to Imagine for an immediate free replacement. Can't say fairer than that, can you? Imagine also publicise the fact they they will normally depatch all orders by first class post within 24 hours of receipt.

Though this may not be the ultimate game (they may be still working on it), it makes nearly all other invaders type 'shoot 'em up' games look like mere childsplay. Arcadia must rank in the top three arcade games on the market for the Spectrum.

All I say to the arcade games fans is that Arcadia is well worth the £5.50 (I'd buy it just to watch the graphics), and beware their next game . . . Schizoids. Though at the time of writing I have not seen a copy, I have been assured that we will be more than a little surprised by its contents.



'Arcadia' is available from Imagine Software, Mason Buildings, Exchange Street East, Liverpool, Merseyside L2 3PN.

Derby Day — Computer Rentals

I have to admit that when I first saw the title of this program I didn't exactly jump for joy; in fact, the thought of looking at another horse race program decidedly made my heart sink. Surely anybody can make three blobs race from one side of the screen to the other?

When I had recovered, I decided to take a risk and load it up. Derby Day takes well over the standard 16K of memory, so it took a little while to load, though it did load, and first go and all! The first screen of the game asks you what sort of punter you are . . . out for fun to deadly serious. Having pressed the key I was pleasantly surprised to see a well designed and colourful display fold out on to the screen. It included a very good picture of 'honest Clive', the bookmaker, which, though it is not three-dimensional still came over very well. A nice extra touch is a horse trotting across the top of the screen just above 'honest Clive', (I wonder what Uncle Clive would think?). When everybody has placed their bets (the game can accomodate anything from 1 to 5 players) the race begins . . .

Instead of just having the horses galloping across the screen, which they do do very well, the race course is also seen to be moving past them, hence making the track rather longer. One of the many nice touches is the fact that you can see little people standing at the side of the track, and when you come near to the finish the grandstand comes into view. The graphics, though not particularly fast or record-breaking, are well designed and nicely arranged. Sound has also been used reasonably well. Though this game seems to have been written almost entirely in BASIC, it has been structured to allow for reasonably good speed. Who wants race horses that are so fast that you can't see them anyway? It might have been a little more exciting if there had been fences so that the horses might fall, but it is still great fun. When the program is running the display is so arranged that it is difficult to miss.

Computer Rentals Ltd seem to be relatively new to the home computer software market, but obviously have reasonably good financial backing to place their good sized adverts. They also supply a program called Galactic Patrol for the 16K ZX81, some other games for the Spectrum, plus a few for the Dragon 32. If their other games are as good as Derby Day then they would definitely be worth thinking about.

So, to conclude, it can be said that the programmer has done a good job, especially considering the subject matter, and they have come up with a pretty good value-for-money cassette for the person who wants a quieter life than defending the world from aliens.

'Derby Day' is available at £6.95 from Computer Rentals Ltd, 140 Whitechapel Road, London E1.

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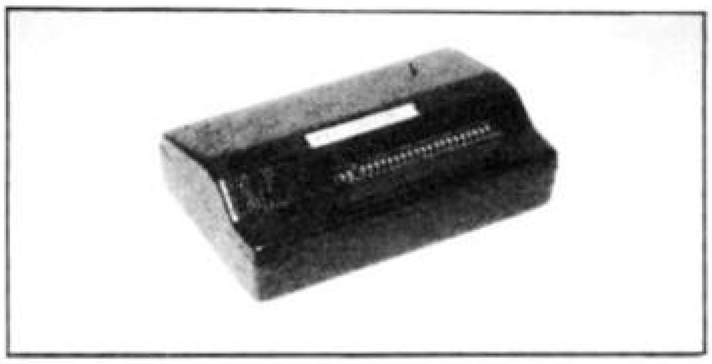
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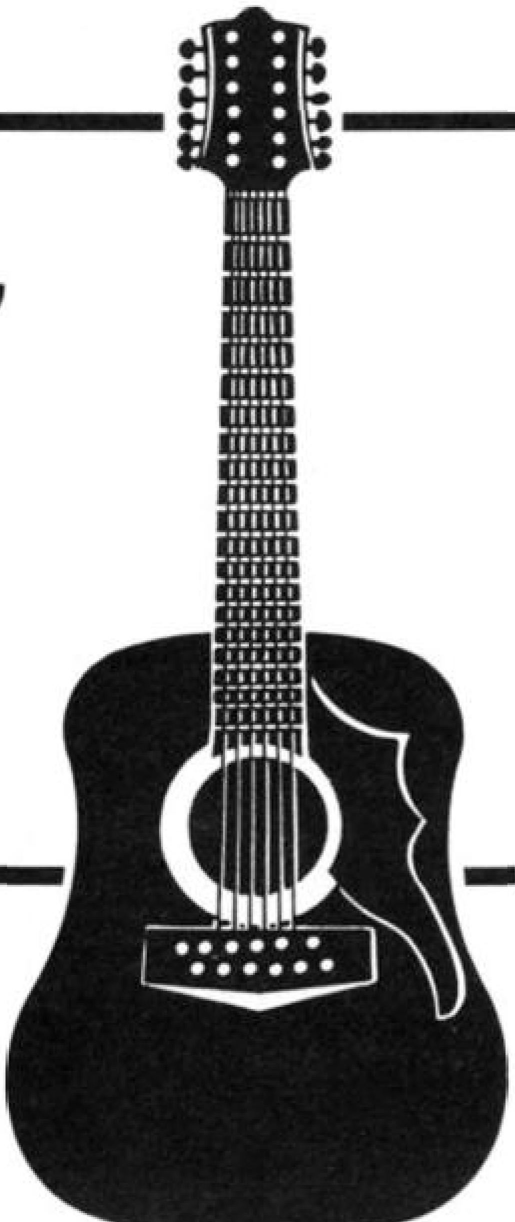
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Mastering machine code on your Spectrum — part 4

Following in her series, Toni Baker, author of 'Mastering Machine Code on your ZX81', transforms your Spectrum into a musical machine.





Long, long ago in a galaxy far, far away, great battles were waged between the humanoids and the space invaders, the spaceships and the asteroids. This world was brought to your attention with the coming of the video age — first in arcades, and now in home computers like the Spectrum. In the comfort of your own home you can gently soothe away all your frustrations by killing untold millions of malevolent aliens, fighting with mystical dragons to rescue beautiful princes from evil wizards, or testing your intelligence with maze games and mastermind puzzles. After all — what else are computers for?

In another sector of the galaxy lay-accountants and businessfolk ponder over the strings of figures being reeled off by the ZX Printer telling them to the nearest penny how much tax they can fiddle before they get caught, or staring for hours at the bland bar-charts and friendly graphs plotting current profit returns against the popularity of 'Crossroads'. After all, computers weren't designed for playing games or were they?

Strumming your Spectrum

Then one day, as I sat drinking coffee and chatting away to my fellow compatriots, wishing I could play the guitar as well as they, a friend introduced me to a *new* concept. Maybe computers have a purpose in life beyond simple sport and science. Surely computers like the ZX81 (for this was a long time ago) had meaning in the fields of *art* and *music* and *culture*. A program, it was suggested, could be viewed as a work of art, with the programmer being the artist. If this were so then most of the programs we see around us are *functional* — analagous to chairs or tables — they were not, in general, *beautiful* — analagous to a painting or a piece of music. It is to this friend that I dedicate this article and, in particular, the program which goes with it.

This is called Cathy's Program, the original version of which appeared in my book **Mastering Machine Code On Your ZX81** and was written for the Sinclair ZX81. This new updated version, however, is written for the ZX Spectrum. Although its basic structure is the same, the individual parts have needed to be entirely rewritten.

The purpose of the program is to turn the Spectrum keyboard into a musical one, so that each key produces a different note, and continues to produce it for as long as the key is held down. The diagram in Fig. 2a shows which key produces which note; there are two octaves, with the lower two rows producing notes from middle C upwards, and the upper two rows the next octave above this. The program is entirely in machine code and once set in motion will continue to run until you break out by pressing Break (Caps Shift and Space) as normal.

New wave music

A small amount of explanation is required before the listing will make sense, and so the first thing I ought to do is explain the principle by which notes are produced on the Spectrum. The most important instruction is OUT (FE),A. The Spectrum can only produce one type of sound — that is, one type of waveform — essentially, a square wave or a rectangular wave. A square wave is a wave which at any instant in time may be either at HIGH potential or at LOW potential; it may never be at an intermediate potential.

Here's what the instruction OUT (FE),A does: suppose A contains the (binary) number 'xxxnxgrb; (each letter represents a binary digit). The xs are

b: O = switch the blue gun off, 1 = switch the blue gun on.
r: O = switch the red gun off, 1 = switch the red gun on.
g: O = switch the green gun off, 1 = switch the green gun on.
n: O = switch the note generator to LOW potential.
1 = switch the note generator to HIGH potential.

Fig. 1. A breakdown of the individual letters of A in the instruction, OUT (FE),A.



for our purposes effectively meaningless, but the other letters:n, g, r and b are quite important. They switch hardware devices on and off (see Fig. 1).

Bits 2, 1 and O then control the overall colour output to the screen. (In practice it is only the BORDER colours which may be changed in this way — the screen colours are controlled by the attribute bytes).

The principle of creating music then is to create a square wave. The procedure for doing this is 'short delay/OUT (FE), xx x1xxxx/short delay/OUT (FE), xxxOxxxx/repeat for as many cycles as required'. Note that doing this will automatically change the BORDER colour. If you wish to avoid this then you must slightly modify the procedure to 'short delay/OUT (FE),xxxOxbbb/short delay/ OUT (FE),xxxOxbbb/repeat for as many cycles as required' where bbb represents the current BORDER colour number in binary.

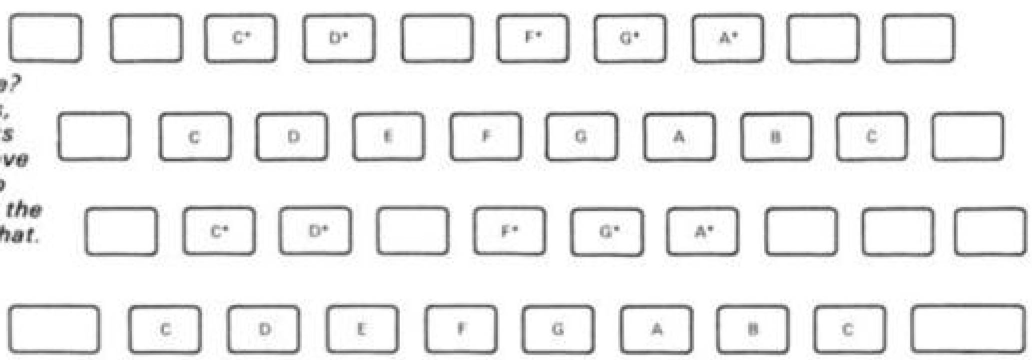
On that note...

Before we look at the finished program, I'd like to introduce you to one of the subroutines in the ROM. The subroutine is called KEY_SCAN, and its effect is to determine which keys, if any, are currently depressed. You can use the subroutine simply by the instruction CALL KEY_SCAN (CD8E02). The machine code registers will all be wiped out by the subroutine so, if you wish to preserve them, you must PUSH them onto the stack and then POP them on return. Register DE will contain the final output of the subroutine as shown in Fig. 3. Also, in the case of two or more keys being pressed simultaneously, the zero flag will be RESET. In all other cases, the zero flag will be SET.

The key codes mentioned in the above description are in all cases a number between 00 and 27. A different number is returned for each key. The codes themselves are listed in Fig. 2b you can see for yourselves that the keys are covered in what at first glance seems to be a very strange order.

There is one final point I have to make before we can turn the Spectrum into a musical instrument. Little things called Interrupts. Fifty times a second, the Spectrum hardware sends a little pulse down one of the pins connected to the Z80 chip. When this happens, one of the following sequences of things will happen, depending upon a previously unheard of flag called the (IFF1 Interrupt Flip/Flop one)

Fig. 2a. Which key on the Spectrum produces which note? There a two octaves, the bottom two rows producing notes above middle C and the top two rows producing the next octave above that. (Note that the sharp (#) notes are indicated with an asterisk.)



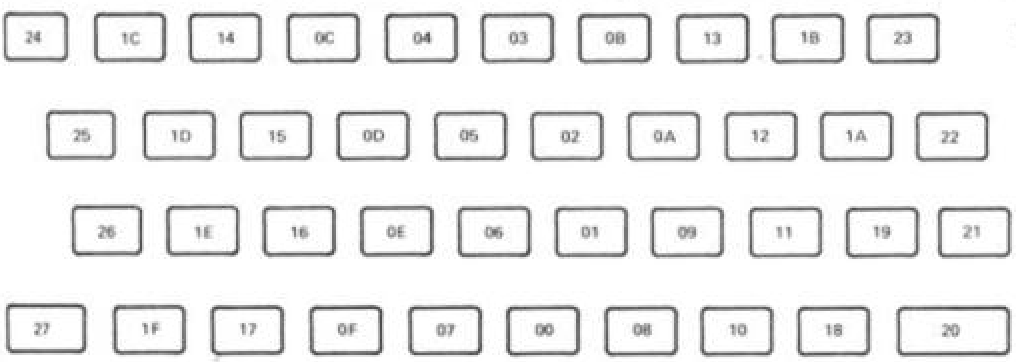


Fig. 2b. The codes, and how they are allocated on the keys of the Spectrum.

Fig. 3. The contents of the register, DE.

SITUATION	VALUE OF DE
No key at all	FFFF
Caps Shift only	FF27
Symbol Shift only	FF18
Both Shifts together	2718
Any key without Shift	FFaa, where aa is the key code of the key concerned.
Any key with Caps Shift	27aa, where aa is the key code of the key concerned.
Any key with Symbol Shift	18aa, where aa is the key code of the key concerned.
Any two keys together	aabb, where aa and bb are the key codes concerned.



```
9E93464B   NOTES   G     G#    G+    F+#  Keys B, H, Y and 6.
0050A9B4           —     F+    F#    F    Keys 5, T, G and V.
8A813D42           A     A#    A+    G+#  Keys N, J, U and 7.
5C5600C1           D+#   E+    —     E    Keys 4, R, F and C.
78003539           B     —     B+    A+#  Keys M, K, I and 8.
6962CFDD           C+    D+    D#    D    Keys 3, E, D and X.
70003200           C+#   —     C++   —    Keys Symbol Shift, L, O and 9.
0070ECFD           —     C+    C#    C    Keys 2, W, S and Z.
00000000           —     —     —     —    Keys Space, Enter, P and O.
00000000           —     —     —     —    Keys 1, Q, A and Caps Shift.

00         SOUND   NOP                    This subroutine causes a
00                 NOP                    very short delay — the exact
00                 NOP                    timing of which is determined
10FB               DJNZ SOUND             by 'B', before sounding
D3FE               OUT (FE),A             a pulse.
C9                 RET
call here:
3A485C     START   LD A,(BORDCR           Bits 5, 4 and 3 contain the
                                          BORDER colour.
1F                 RRA
1F                 RRA
1F                 RRA
E607               AND 07                 A: BORDER colour.
F610               OR 10                  A: BORDER colour but with
                                          bit 4 set.
4F                 LD C,A                 C: BORDER colour + bit 4 set.
F3                 DI                     Disable Interrupts.
C5         LOOP    PUSH BC                Preserve the value of C.
CD8E02             CALL KEY_SCAN          Scan the keyboard.
C1                 POP BC                 Restore the value of C.
212027             LD HL,2720             HL: the key value for 'Caps
                                          Shift Space'.
A7                 AND A                  Reset carry flag.
ED52               SBC HL,DE              Compare key pressed (if any)
                                          with 'Caps Shift Space'.
281B               JR Z, EXIT             Exit program if desired.
7B                 LD A,E                 A:= key code (ignoring Shifts).
3C                 INC A
28EF               JR Z,LOOP              Loop if no key pressed.
AF                 XOR A                  A: zero.
57                 LD D,A                 DE: key code ignoring Shifts.
21 notes           LD HL,NOTES
19                 ADD HL,DE              Point HL to note value in table.
46                 LD B,(HL)              B: note value.
B8                 CP B                   Compare B with zero.
28E5               JR Z,LOOP              Loop if no note on that key.
79                 LD A,C                 A: border colour (bit 4: 1).
C5                 PUSH BC                Preserve the value of B.
CDsound            CALL SOUND             Generate first half cycle.
C1                 POP BC                 Restore the value of B.
E607               AND 07                 A: BORDER colour (bit 4: 0).
CDsound            CALL SOUND             Generate second half cycle.
18D8               JR LOOP                Repeat sequence.
FB         EXIT    EI                     Enable Interrupts.
C9                 RET                    End of routine.
```

Fig. 4. Cathy's program.

(The people who name these things must have some sense of humour!):

If IFF1 = O then: do nothing.
If IFF1 = 1 then: Stack all registers onto the machine stack;
CALL 0038 is executed — this does the following:
increment the system variable FRAMES;
scan the keyboard, updating the system variables KSTATE and LAST_K.
POP all registers from the stack and carry on as before.

The normal state of the flat IFF1 is one, so that all programs, machine code or BASIC, are slowed down because the subroutine at 0038 is executed 50 times a second without our knowledge or consent. With regard to music, it means the exact timing we require in order to produce square waves of the right wavelength will be totally wrong since we shall have no idea as to whether or when the interrupt routine will be carried out in any given cycle. In order to overcome this problem, it is necessary to reset IFF1 to zero so that the above sequence of events will not be carried out. The instruction DI (Disable Interrupts) is equivalent to saying LET IFF1 = O, and so this, then, is the instruction we need.

When the Spectrum, in normal use, waits for a key to be pressed, what is *really* happening is that it is waiting for K_STATE to change. Note that this can only happen if IFF1 = 1, for otherwise the subroutine at 0038 will never be called and the Spectrum will just sit there waiting forever, while the poor old user can do nothing but gnash teeth and throw bricks at the television. In order to prevent this from happening EI, (Enable Interrupts or LET IFF1 = 1) must be executed before returning to BASIC. Any machine code program which runs while the interrupts are disabled may only scan the keyboard by using IN ,(FE) instructions, or by CALLing KEY_SCAN, *not* by examining K_STATE or LAST_K.

Figure 4, then, is the final result: Cathy's Program for the Spectrum. Despite its lengthy appearance, it is actually quite short and doesn't take very long to feed in at all. To all musicians out there — behold your new instrument!

In my next article I shall continue on the theme of creativity, but with attention turned toward the visual, rather than the audial.

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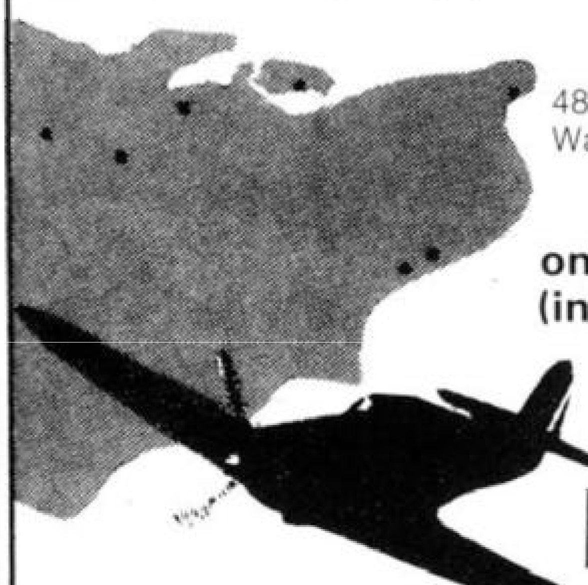
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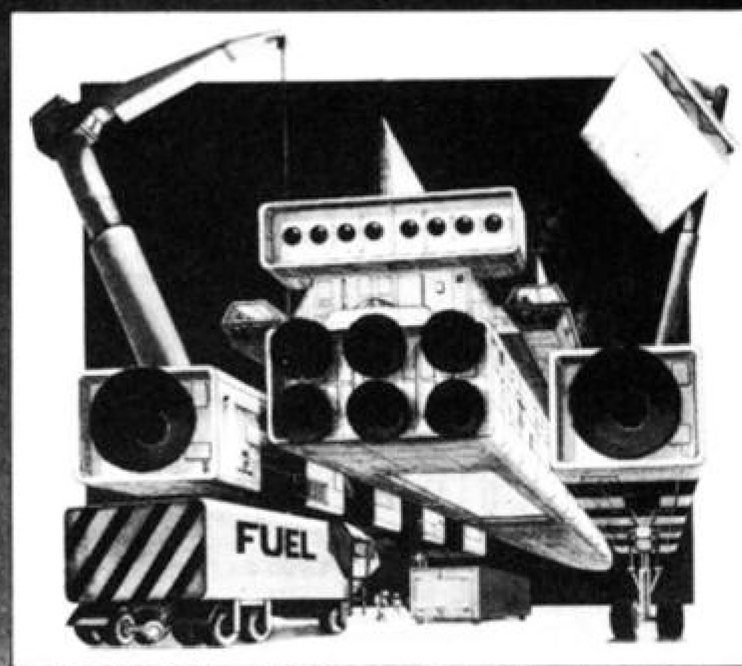
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Software selection

If you're looking for software for your Sinclair computer, check out our comprehensive checklists first!

The trouble with owning a ZX81 computer is that you are invariably spoilt for choice when it comes to software. Look through any computer magazine and you will find yourself floundering is a sea of software titles.

In this special feature, we have gathered together a comprehensive selection of titles currently available on the market. To help you further, you will also find the type of program, either game (G), business (B), Domestic (D), Utility (U), or Educational (E), the company you should contact and the price of the cassette. At the back of the listings, you will find a list of all the companies mentioned, complete with an address at which further enquiries may be made.

Happy hunting!

Apologies

If you supply software cassettes and you do not find your products mentioned in these lists, please write to ZX Computing, marked for the special attention of the Deputy Editor, and when it comes round to updating this feature for inclusion in a future issue, we will be able to include your software titles.





ZX81 software

1K Chess	G	Artic	1K	£2.95
1K Fun Learning	E	A. Parsons	1K	£3.95
1K Games Pack	G	Artic	1K	£6.00
1K Maths	E	Mr Purves	1K	£3.50
1K Super Trio	G	Software Masters	1K	£7.95
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3-D Labyrinth	G	dK'tronics	16K	£3.95
3-D Monster Maze	G	J K Greye	16K	£4.95
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Action Games	G	A Parsons	16K	£4.95
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Adventure	G	Abersoft	16K	£8.95
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Adventure 3	G	D J Moody	16K	£5.00
Adventure 4	G	D J Moody	16K	£5.00
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AM-ZXMON	U	Amersham Software	16K	£6.00
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Asteroids	G	Mikro Gen	16K	£3.95
Asteroids	G	Silversoft	16K	£3.95
Asteroids	G	The Software Farm	16K	£5.95
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Astro Invaders	G	John Prince	16K	£3.65
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Awari	G	Understanding	16K	£5.95
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Breakout	G	Bug Byte	1K	£3.50
Breakout	G	J K Greye	1K	£1.95
Breakout	G	Mikro Gen	16K	£3.95
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Business Model Modeller X	D	Cases Computer Simulations	16K	£8.00
Business Pack	B	Transform	16K	£25.00
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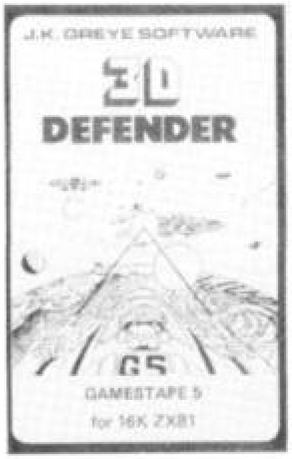
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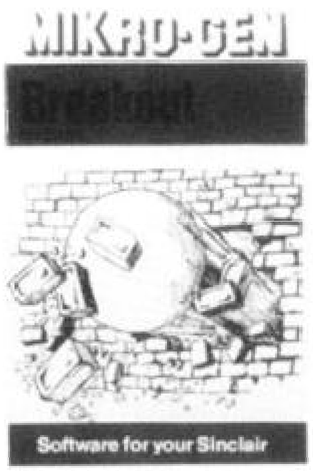
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MACHINE SPECIFICATIONS

ZX80

Dimensions
Width 174mm (6.85 in)
Depth 218mm (8.58 in)
Height 38 mm (1. 5 in)
Weight 300g (10.5oz)

Microprocessor/Memory
Z80A 3.25 MHz clock
ROM: 4K bytes containing BASIC
RAM: 1K bytes internal, externally expandable to 16K bytes.

Display
Requires an ordinary domestic black and white colour TV. The lead supplied connects between the ZX80 and your TV's aerial socket. The display organisation is 24 lines of 32 characters per line showing black characters on a white screen. The ZX80 does not connect to a printer.
Programming
Programs can be entered on the keyboard or loaded from cassette. The ZX80 has automatic "wrap round" so lines of program can be any length but not multi-statement lines.
Syntax check
The syntax of the entered line is checked character by character. A syntax error cursor marks the first place the syntax breaks down if there is an error. Once any errors have been edited out the syntax error cursor disappears. Only syntax error-free lines of code are accepted by the ZX80.
Graphics
Total of 22 graphics symbols giving 48 x 64 pixels resolution consisting of 10 symbols plus space and inverses. Includes symbols for drawing bar charts. Under control of your BASIC program any character can be printed in reverse field.
Editing
The line edit allows you to edit any line of program or input including statement numbers. The edit and cursor control keys are EDIT, RUBOUT, HOME.
Arithmetic
Arithmetic operators +,–,x, ÷ exponentiate. Relational operators <, >, = , yielding 0 or – 1. Logical operators AND OR NOT yielding boolean result. Relational operators also apply to strings. ZX80 BASIC uses 16 bit two's complement arithmetic (± 32767).
Variables
Numeric variable names may be any length, must begin with a letter and consist of alphanumerics. Every character in the name is compared thus an infinity of unique names is available.
String variables may be assigned to or from, shortened but not concatenated. String variable names are A$ – Z$. Strings do not require a dimension statement and can be any length.
Arrays have a maximum dimension of 255 (256 elements) each. Array names consist of a single letter A–Z.
Control variable names in FOR. . . NEXT loops consist of a single letter A–Z.

Expression evaluator
The full expression evaluator is called whenever a constant or variable is encountered during program execution. This allows you to use expressions in place of constants especially useful in GOTOs, GOSUBs, FOR. . . NEXT etc.

Immediate mode
The ZX80 will function in the "calculator mode" by immediately executing a statement if it is not preceded with a line number.
Cassette interface
Works with most domestic cassette recorders. The transfer rate is 250 baud using a unique tape-recording format. Other systems are not compatible with the ZX80's. The ZX80 also SAVEs the variables as well as the program on cassette. Therefore you can save the data for updating next time the program is executed. The ZX80 does not support separate data files. The lead supplied with the ZX80 is fitted with 3.5mm jack plugs.
Expansion bus
At the rear has 8 data, 16 address, 13 control lines from the processor and Ov, 5v, 9-11v, Ø and internal memory control line. These signals enable you to interface the ZX80 to your own electronics, PIO, CTC, SIO if you want I/O ports etc.
Power supply
The ZX80 requires approximately 400mA from 7–11v DC. It has its own internal 5v regulator.
TV standard
The ZX80 is designed to work with UHF TVs (channel 36)and is the version required for use in the United Kingdom. The ZX80 USA is designed to work with a VHF TV(American channel 2. European channel 3) and is the version required for the American TV system, also for countries without UHF.

ZX81

Dimensions
Width 167mm (6.32 in)
Depth 175mm (6.80 in)
Height 40 mm (1.57 in)
Weight 350 gms (12.15 oz)

Microprocessor/Memory
Z80A 3.25 MHz clock
ROM: Containing 8K BASIC interpreter
RAM: 1K bytes internal, externally expandable to 16K bytes.

Keyboard
40 key touch-sensitive membrane. Using function mode and single press key-word system, this gives the equivalent of 91 keys and also graphics mode allows an additional 20 graphical and 54 inverse video characters to be entered directly.
Display
Requires an ordinary domestic black and white or colour TV. The aerial lead supplied connects the ZX81 to the TV aerial socket. The display is organised as 24 lines of 32 characters with black characters on a white background.
Two mode speeds
The ZX81 can operate in two software-selectable modes - FAST and NORMAL. FAST is ideal for really high-speed computing. In NORMAL mode however the ZX81 allows continuously moving, flicker-free animated displays.
Printer
The 8K ROM will permit instructions (LPRINT, LLIST and COPY) to drive the Sinclair ZX Printer.
Programming
Programs can be entered via the keyboard or loaded from cassette. Programs and data can be saved onto cassette so that they

are not lost when the ZX81 is turned off.

Syntax check

The syntax of a line of program is checked on entry. A syntax error cursor marks the first place the syntax breaks down if there is an error. The syntax error cursor disappears when errors have been corrected. Only lines free from syntax errors will be entered into the program.

Graphics

Apart from the 20 graphics characters, space and its inverse, the display may also be divided into 64 x 44 pixels, each of which may be 'blacked' in or 'whited' out under program control.

Editing

A line editor allows you to edit any line of program or input, including program line numbers. Lines may be deleted, increased or decreased in size.

Arithmetic

Arithmetic operators +, –, x, ÷, exponentiate. Relational operators =, < >, >, <,< =,>=, may compare string and arithmetic variables to yeild 0 (False) or 1(True). Logical operators AND, OR, NOT yield boolean results.

Floating-point numbers

Numbers are stored in 5 bytes in floating-point binary form giving a range of $\pm$ 3 x 10^{-39} to $\pm$ 7 x 10^{38} accurate to 9½ decimal digits.

Scientific functions

Natural logs/antilogs; SIN, COS, TAN and their inverses;SQR; e^x.

Variables

Numerical:	any letter followed by alphanumerics
String:	A$ to Z$
FOR-NEXT loops:	A–Z (loops may be nested to any depth.
Numerical arrays:	A–Z
String arrays:	A$ to Z$

Arrays

Arrays may be multi-dimensional with subscripts starting at 1.

Expression evaluator

The full expression evaluator is called whenever an expression, constant or variable is encountered during program execution. This powerful feature allows use of expressions in place of constants and is especially useful in GOTO, GOSUB etc.

Command mode

The ZX81 will execute statements immediately, enabling it to perform like a calculator.

Cassette interface

Works using domestic cassette recorders. The transfer rate is 250 baud and uses a unique recording format not compatible with other systems. The ZX81 will save the data as well as the program to avoid the need to re-enter the data when the program is next loaded.,

ZX81 will search through a tape for the required program). The cassette leads supplied have 3.5 mm jack plugs.

Expansion port

At the rear, this has the full data, address and control buses from the Z80A CPU as well as OV, +5V, +9V,Ø and the memory select lines. These signals enable you to interface the ZX81 to the Sinclair 16K RAM pack and ZX printer.

Power supply

The ZX81 requires approximately 420mA at 7–11V DC. It has its own internal 5V regulator. The ready assembled ZX81 comes complete with a power supply. The ZX81 kit does not include a power supply.

TV standard

The ZX81 is designed to work with UHF TVs (channel 36) 625 lines.

ZX SPECTRUM

Dimensions

Width 233 mm
Depth 144 mm
Height 30 mm

CPU/Memory

Z80A microprocessor running at 3.5 MHz. 16K-byte ROM containing BASIC interpreter and operating system.
16K-byte RAM (plus optional 32K-byte RAM on internal expansion board) or 48K-byte RAM.

Keyboard

40-key keyboard with upper and lower case with capitals lock feature. All BASIC words obtained by single keys, plus 16 graphics characters, 22 colour control codes and 21 user-definable graphics characters. All keys have auto repeat.

Display

Memory-mapped display of 256 pixels x 192 pixels; plus one attributes byte per character square, defining one of eight foreground colours, one of eight background colours, normal or extra brightness and flashing or steady. Screen border colour also settable to one of eight colours. Will drive a PAL UHF colour TV set, or black and white set (which will give a scale of grey), on channel 36.

Sound

Internal loudspeaker can be operated over more than 10 octaves (actually 130 semitones) via basic BEEP command. Jack sockets at the rear of computer allow connections to external amplifier/ speaker.

Graphics

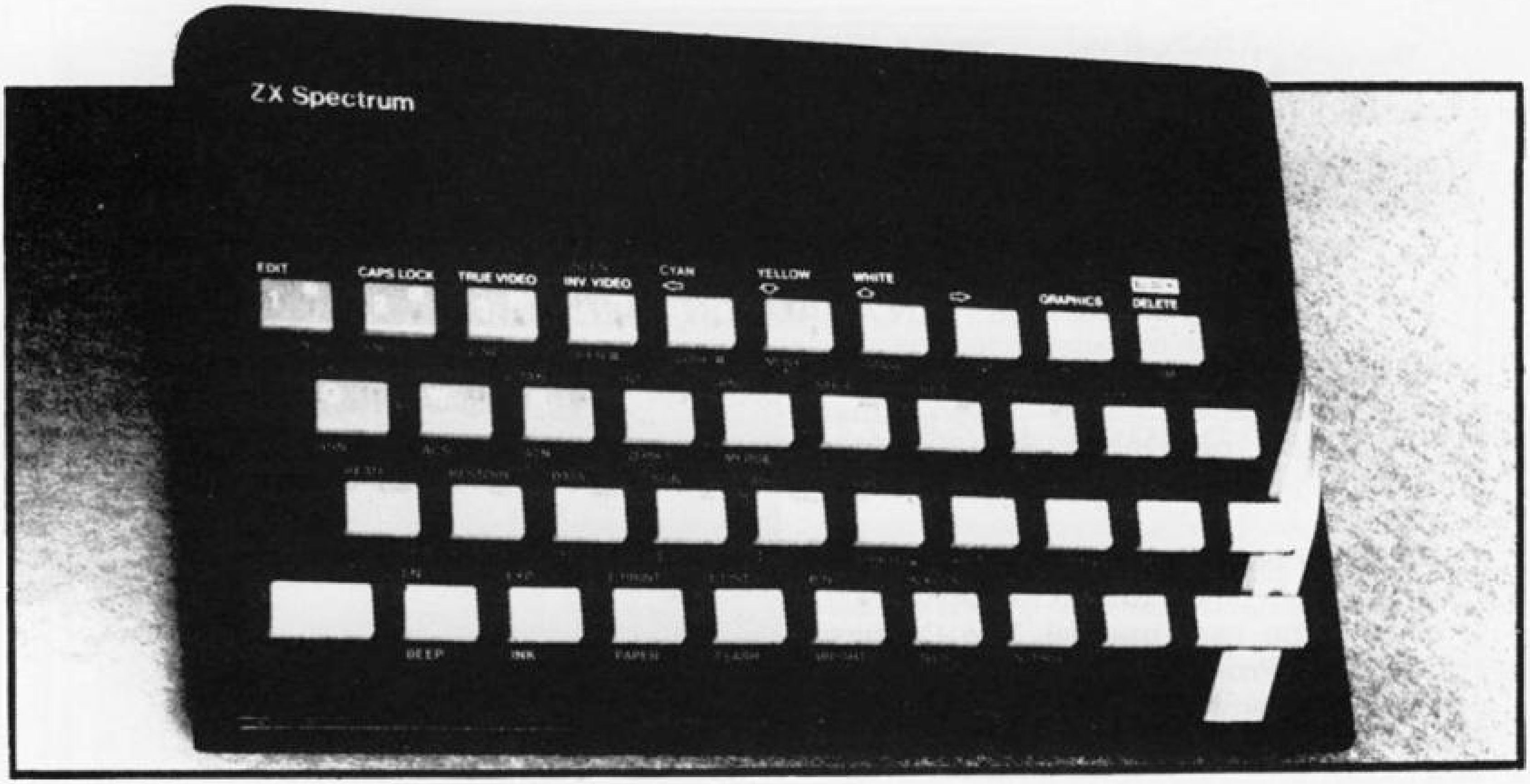
Point, line, circle and arc drawing commands in high-resolution graphics.
16 pre-defined graphics characters plus 21 user-definable graphics characters. Also functions to yield character at a given position, attribute at a given position (colours, brightness and flash) and whether a given pixel is set. Text may be written on the screen on 24 lines of 32 characters. Text and graphics may be freely mixed.

Colours

Foreground and background colours, brightness and flashing are set by BASIC INK, PAPER, BRIGHT and FLASH commands. OVER may also be set, which performs an exclusive — or operation to overwrite any printing or plotting that is already on the screen. INVERSE will give inverse video printing. These six commands may be set globally to cover all further PRINT, PLOT, DRAW or CIRCLE commands, or locally within these commands to cover only the results of that command. They may also be set locally to cover text printed by an INPUT statement. Colour-control codes, which may be accessed from the keyboard, may be inserted into text or program listing, and when displayed will override the globally set colours until another control code is encountered. Brightness and flashing codes may be inserted into program or text, similarly. Colour-control codes in a program listing have no effect on its execution. Border colour is set by a BORDER command. The eight colours available are black, blue, red, magneta, green, cyan, yellow and white. All eight colours may be present on the screen at once, with some areas flashing and others steady, and any area may be highlighted extra bright.

Screen

The screen is divided into two sections. The top section — normally the first 22 lines — displays the program listing or the results of program or command execution. The bottom section — normally the last 2 lines — shows the command or program line currently being entered, or the program line currently being edited. It also shows the report messages. Full editing facilities of cursor left, cursor right, insert and delete (with auto-repeat facility) are available over this line. The bottom section will expand to accept a current line of up to 22 lines.



Mathematical Operations And Functions

Arithmetic operations of +, −, ×, ÷, and raise to a power. Mathematical functions of sine, cosine, tangent and their inverses; natural logs and exponentials; sign function, absolute value function, and integer function; square root function, random number generation, and pi.

Numbers are stored as five bytes of floating point binary — giving a range of $+3 \times 10^{-39}$ to $+7 \times 10^{38}$ accurate to 9½ decimal digits. Binary numbers may be entered directly with the BIN function. =, >, <, >=, <= and <> may be used to compare string or arithmetic values or variables to yield 0 (false) or 1 (true). Logical operators AND, OR and NOT yield boolean results but will accept 0 (false) and any number (true).

User-definable functions are defined using DEF FN, and called using FN. They may take up to 26 numeric and 26 string arguments, and may yield string or numeric results.

There is a full DATA mechanism, using the commands READ, DATA and RESTORE.

A real-time clock is obtainable.

String Operations And Functions

Strings can be concatenated with +. String variables or values may be compared with =, >, <, >=, <=, <> to give boolean results. String functions are VAL, VAL$, STR$ and LEN. CHR$ and CODE convert numbers to characters and vice versa, using the ASCII code. A string slicing mechanism exists, using the form a$ (x TO y).

Variable Names

Numeric — any string starting with a letter (upper and lower case are not distinguished between, and spaces are ignored).
String — A$ to Z$.
FOR-NEXT loops — A-Z.
Numeric arrays — A-Z.
String arrays — A$ to Z$.
Simple variables and arrays with the same name are allowed and distinguished between.

Arrays

Arrays may be multi-dimensional, with subscripts starting at 1. String arrays, technically character arrays, may have their last subscript omitted, yielding a string.

Expression Evaluator

A full expression evaluator is called during program execution whenever an expression, constant or variable is encountered. This allows the use of expressions as arguments to GOTO, GOSUB, etc.

It also operates on commands allowing the ZX Spectrum to operate as a calculator.

Cassette Interface

A tone leader is recorded before the information to overcome the automatic recording level fluctuations of some tape recorders, and a Schmitt trigger is used to remove noise on playback.

All saved information is started with a header containing information as to its type, title, length and address information. Program, screens, blocks of memory, string and character arrays may all be saved separately.

Programs, blocks of memory and arrays may be verified after saving.

Programs and arrays may be merged from tape to combine them with the existing contents of memory. Where two line numbers or variables names coincide, the old one is overwritten.

Programs may be saved with a line number, where execution will start immediately on loading.

The cassette interface runs at 1500 baud, through two 3.5 mm jack plugs.

Expansion Port

This has the full data, address and control busses from the Z80A, and is used to interface to the ZX Printer, the RS232 and NET interfaces and the ZX Microdrives. IN and OUT commands give the I/O port equivalents of PEEK and POKE.

ZX81 Compatibility

ZX81 BASIC is essentially a subset of ZX Spectrum BASIC. The differences are as follows.

FAST and SLOW: the ZX Spectrum operates at the speed of the ZX81 in FAST mode with the steady display of SLOW mode, and does not include these commands.

SCROLL: the ZX Spectrum scrolls automatically, asking the operator "scroll?" every time a screen is filled.

UNPLOT: the ZX Spectrum can unplot a pixel using PLOT OVER, and thus achieves unplot.

Character set: the ZX Spectrum uses the ASCII character set, as opposed to the ZX81 non-standard set.

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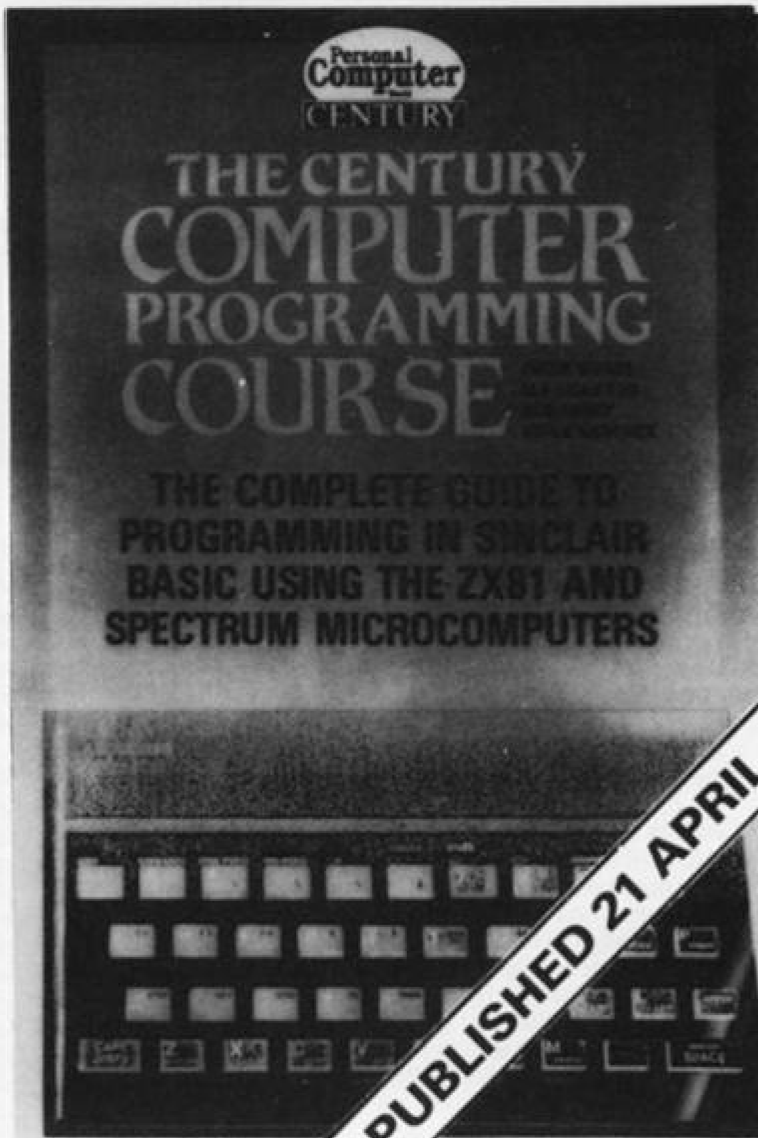
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Addictive Games 116
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Audio Computers 139
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Bi Pak 72
C.C.S. 97
Campbell Systems 121
Century Publishing 138
Computerlock 51
Cascade Software 52
Carnell Software 80
Cheetah Marketing 117
Computer Rentals 116
Easternsoft 72
East London Robotics 131
Educare 131
Fulcrum 117
Fosberry AG 3
Peter Furlong 82
Foilkade 97
File Sixty 23
Gibbon JP 96
Hewson 59
Haven 87
Hilderbray 132
Impact 72
J. K. Greye 102
Kuma 3
Linsac 73
Lovejoy 100
Micropower 22
McLotharian 6
Melbourne House 64
Moviedrome Video 22
Memotech 46-47
Microware 23/52
Microsphere 102
Micro Game Simulations 121
Mikrogen 97
Nimrod 131
New Generation Software 132
Nottingdale 34
Print & Plotter 12
Picturesque 72
Phipps 6
Quicksilva 140/121
Richard Shepherd 43
Rose Cassettes 22
Softek 35
Software Bank 102
Stonechip 3
Silversoft 2
Software Farm 51/132
Software Supermarket 17
Sinclair Research 38/39
Tasword 73
Timedata 110
UTS 110
University Computers 110
V & H 96
Warp Factor 8 116